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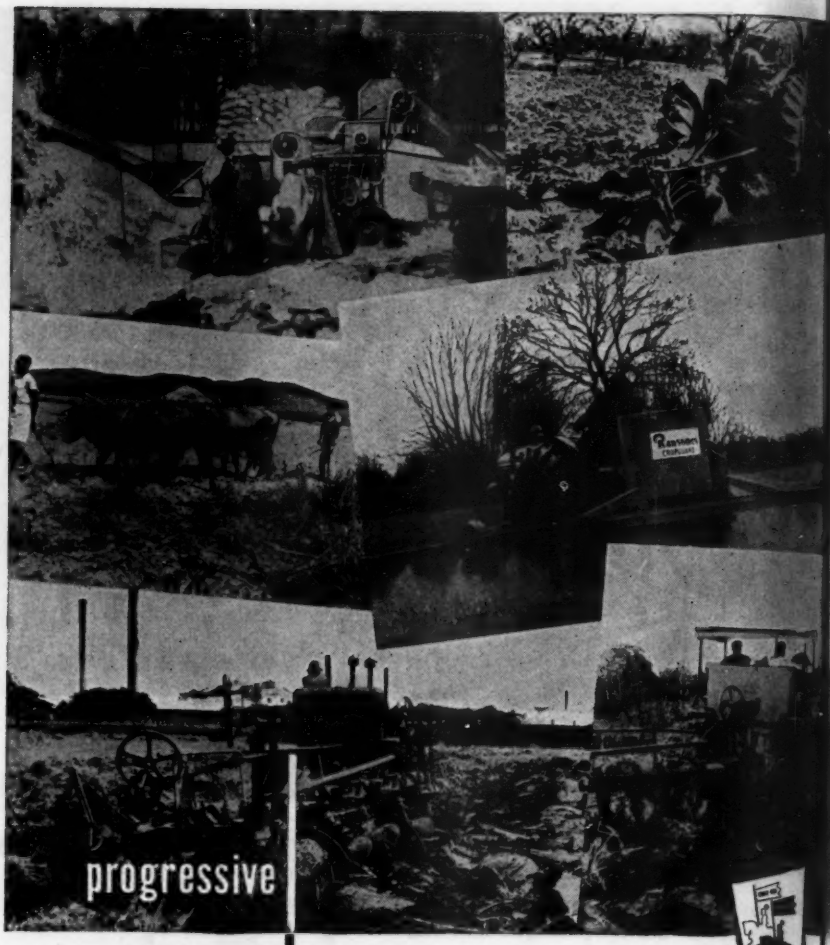

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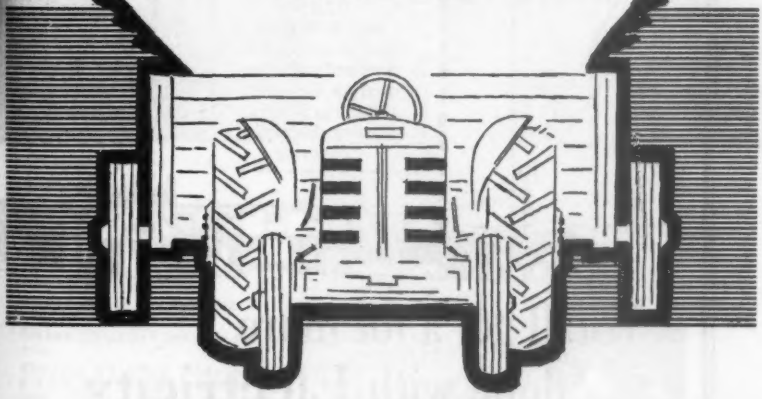

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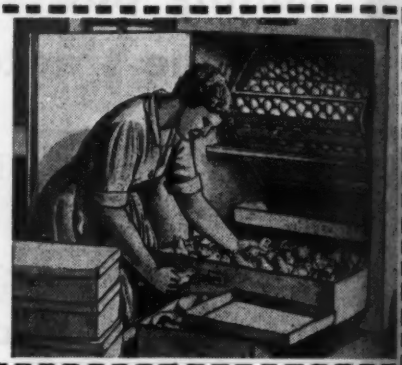

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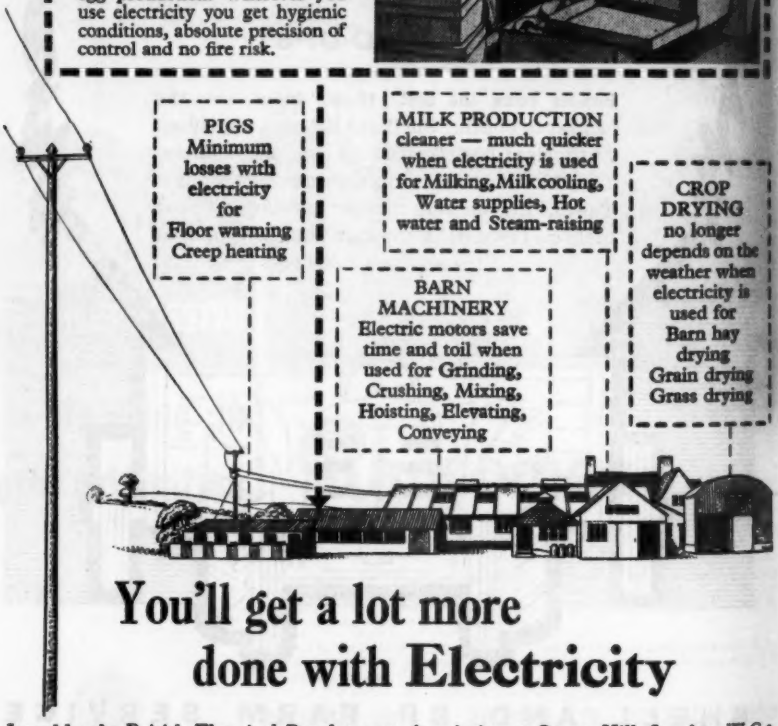

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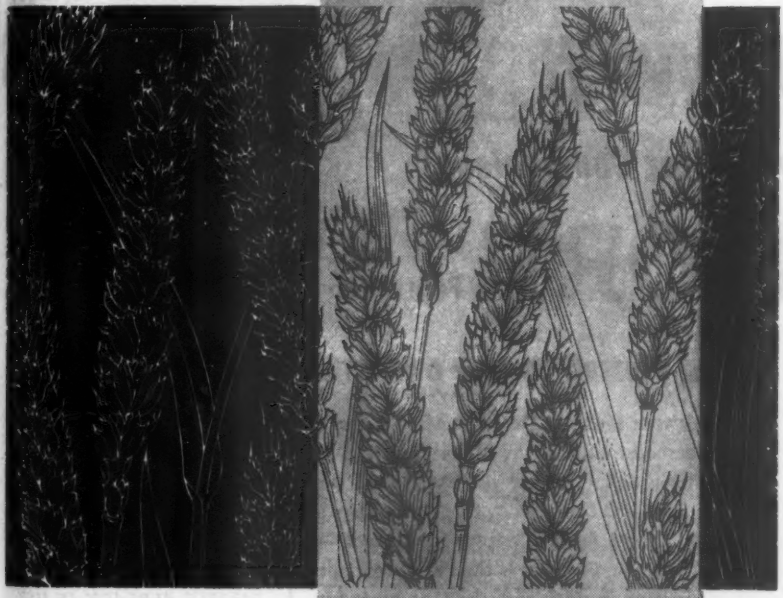

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AGRICULTURE

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MAN AND HIS RESOURCES

S. R. O'HANLON, M.B.E.
Editor, Agriculture

The recent report published by Political and Economic Planning, *World Population and Resources* (Allen and Unwin, 30*s*.), surveys the world's natural and economic resources in relation to expected population growth over the next few decades.

THE shadow of Malthus continues to be projected across the world. In its essentials, the problem before us today is the same as that which he pondered just on a hundred and sixty years ago. The difference is one only of degree. Simply stated, it is: how many people can the world support in full health and reasonable comfort, given full use of all its resources? The opening up of new lands and, more recently, the agrarian advances that have been made, have merely postponed the attention which sooner or later we must give to its solution.

During the past ten years, a period particularly marked by a growing consciousness of demographic problems, many books and innumerable articles have been addressed to the examination of this question, but none perhaps so usefully as the recent report by PEP. This report has none of the flesh-creeping qualities which have characterized some of its predecessors, but the cold facts of the survey speak for themselves and must unfailingly impress the reader with the serious situation which exists when a steadily mounting world population threatens to overtake and outstrip its natural resources—particularly food. Minerals and the various sources of energy are, it is thought, likely to be sufficient to meet reasonable economic development during the next twenty-five years (the period covered by the report), but food production, sustained at a level to ensure full health, is going to be exceedingly difficult. The difficulty is more clearly appreciated when we remember that only a little more than one-tenth of the world's land mass is readily cultivable, that all except the more difficult areas is already in use, and that two-thirds of the present world population is underfed. Even to secure a fully adequate diet immediately, without any provision for a multiplying population, the total increase in available food would have to be of the order of 25 per cent.

The rate of statistical increase in world numbers is given by the report to be over 80,000 a day—some 30 million a year. Reduced to figures with which the mind can more easily grapple, it means that in the ten minutes that it may take to read this short article, another 600 have been added. Over the last hundred years the rate of increase has been continually accelerated and is now growing fastest in the more thinly populated countries of America, Africa and Oceania; it is slowest in the more densely settled areas of Europe and elsewhere. At the moment, it is apparently only in Egypt and Asia that population pressures are becoming embarrassing. In the last fifty years the population of Egypt has almost doubled itself, giving a density of 1,500 to the square mile. By contrast, the area of cultivation

has increased very little—understandably so, since reclamation of the Sahara desert is limited by the amount of water that can be brought by irrigation from the Nile. India's population is approaching the 400 million mark at a rate of nearly 5 million a year; and there is relatively little more land to press into cultivation The 1953 census of China recorded a population of 600 million (one-quarter of the world's whole), to which 12 million are being added every year. Like those of the Nile and the Ganges, the river valleys of China are grossly over-populated.

In other parts of the world, the pattern is different. We find thinly populated countries with their resources largely undeveloped. For example, Brazil, which is rich in physical wealth but lacks the touchstone of cheap and accessible power to set the wheels of economic development fully turning.

Canada, with its population of only four to the square mile, is the outstanding example of a thinly peopled yet relatively well-developed country. She has vast natural resources, the world's cheapest hydro-electric power, and her food production has grown twice as fast as her population.

Considered globally, the equation of man and his food resources is seen to be a problem beside which all others dwindle. So many diverse factors—geographical, political, economic and social—play upon the question. There is no sovereign remedy, no quick answer. We have to accept the fact that, other things being equal, world population is likely to rise well above the 3,000 million mark in the fairly near future. But clearly, a beginning must be made, and the report suggests certain lines of action which can be taken. These include an acceptance, both by governments and people, of some degree of population control, especially in those areas where the increases have already been shown to be beyond the power of the land to support them in other than poverty and squalor. Such conditions lead inevitably to social instability, unrest and, ultimately, distintegration.

At the same time we must look to the conservation of our resources. The history of mankind has not been remarkable for his concern with the future. "Sufficient unto the day . . ." has too often been the working philosophy, and we are perhaps being wise after the event when we condemn past generations for their prodigal use of the earth's natural wealth. Soil, water, forests and fisheries are fundamental assets, not to be exploited and abused but husbanded scientifically for the production of greater wealth. To this end, they must be seen as a natural inheritance, and a greater sense of responsibility for their trust inculcated.

The great advances which have been made in agricultural science can also make an enormous contribution to the solution of this problem. Higher yields of crops and stock by better breeding and management, the reduction and control of pests and diseases which at present continue to take a fantastically high toll of human food, more economic systems of land tenure and operation: all these can help to feed the extra millions if we can devise the means of bringing financial and technical aid to all areas of need. There must also be education in the new concepts and the new methods, for prejudice, superstition, conservatism and inertia are commonly met barriers to progress. With the wise deployment of capital, a great deal can likewise be done to reclaim the so-called "marginal" wastelands—desert, swamp and scrub. The modern world has the knowledge to do all these things. Has it the wisdom?

It is to be hoped that this report from PEP will help materially (as it can) to set in motion those forces that will shape world opinion and engender an active realism in the tackling of this literally vital problem.

OUR FEEDINGSTUFFS

PROFESSOR M. McG. COOPER, B.AGR.SC.(N.Z.), B.LITT.
King's College, Newcastle-upon-Tyne

Our balance of payments requires that we grow more of our protein stockfoods and import less. Look to the leys, says Professor Cooper.

THE very great advantage which the Danes have as bacon producers is not mainly attributable to the genetic superiority of their Landrace pigs, which may be worth two or three shillings a score to them. Far more important is the fact that Danish farmers are their own provender suppliers, growing most of what they require for their pigs and compounding their own rations. The same situation holds for poultry and dairy production. The consequence is that they are able to sell their produce at prices that would spell ruin to British farmers. Think of the chaos which would reign here if bacon prices fell to less than 40*s*. per score dead weight and milk to less than 2*s*. a gallon! We should be back to the conditions of the depressed 'thirties. Yet the Danes have no special natural advantages, for their climate is much severer than ours and Danish soils are not inherently very fertile. They have made good their deficiencies by determination, a unique ability to co-operate, and a capacity to apply available technical knowledge to their farming operations.

We in British farming, on the other hand, have depended too much on someone else to do many of our jobs, and we are not sufficiently self-reliant or self-sufficient. This makes our farming very vulnerable in times of crisis, as we found to our cost at the outbreak of war. Then pig and poultry populations had to be cut and milk yields fell because Britain was largely cut off from supplies of imported feedingstuffs. Before the war we were not really farming our own acres, except in the traditional tillage counties, and there were nineteen million acres, mainly of poor permanent grass, which were primarily a source of roughage and indifferent summer grazing.

The war changed all this and seven million acres of this permanent grass came into tillage. By 1952, despite the fall in imported feedingstuffs to approximately half the pre-war level, milk production was up by 40 per cent and pigmeat and eggs were also materially increased. Indeed, the most spectacular feature of the agricultural revival was less the volume of expansion than the manner in which it was achieved. One felt that our farming was gaining a real independence and, though there remained many million acres of permanent grass which were in urgent need of the plough, our agriculture was based on the soils of Britain to a much greater extent than it had been since the days of high farming during the middle part of last century.

Now we are backsliding to our old pre-war habits of relying too much on bought food for pigs, cows and hens; as a consequence, feedingstuffs, especially coarse grains, are being imported in such large quantities that they are becoming an embarrassing drain on exchange reserves. Farmers owe it to the future of their industry that the country should be more self-reliant in respect of animal food. More directly, they owe it to their personal interests that they should become really efficient ley farmers, for in such a course of action lies the greatest promise for their future.

Neglect of Grass Now this does not imply that small farmers with irregular fields of three or four acres in the wetter districts, where corn production is costly and hazardous, should emulate the East Anglian. Their farming must be based on grass, with the plough coming in mainly to maintain that grass and to provide supplementary forage crops such as kale. But there must be a very different attitude to grass. In those districts which are best suited for highly productive grassland farming there is at the moment a very high proportion of permanent grass and a very low use of fertilizers. Too many accept grass as they do fresh air and do little about it. Their deficiencies as grassland farmers are brought into vivid relief by the achievements of men like Cray in Hampshire, Solly in Kent and Owens in Somerset, who have shown what grass will do if it is properly managed and if there is a full confidence in grass and its products as a basis for feeding cows.

At the present time average annual production in milk-selling herds is about 700 gallons, and average concentrate use, both home-produced and purchased, is well over a ton per cow. In other words, grassland and the bulky forage crops, according to conventional estimates, are providing not more than maintenance and 100 gallons per cow. This is sheer nonsense, for with milk sales of 700 gallons per cow, concentrate usage should not exceed 10-12 cwt. per cow. It is very bad business if it does, for concentrates are quite the dearest source of nutriment we have for dairy cows, as R. A. Hamilton* has recently shown. On the other hand, grass as grazing is the cheapest form of nutriment, at about only one-fifth of the cost of purchased dairy cake. Dairying in all districts, but especially in the west, must be based on the concentrate-sparing functions of grass and its products.

As one moves east, however, provided soil conditions permit, the emphasis should move more and more to tillage, with the ley functioning primarily as a pivot in the maintenance of soil fertility. This does not mean that the ley should not continue to be the major source of nutriment for dairy cows and other grazing stock—much to the contrary, for even in the easternmost counties there are many examples of high production from grassland. The reason for the change of emphasis is the profitable alternative uses for land in these districts. There is no question, for instance, but that cereal production, combined with sugar beet and potatoes, when properly organized, is one of the most profitable of our farming ventures. When a man can regularly grow a 35 cwt. crop of cereals for £18 per acre and get more than £22 per ton for his corn, he is well advised not to sacrifice barley or wheat acreage in order to keep more cows, which are unlikely to give him such a high net return.

The Worth of Corn Many people are nervous of the future of our corn production because there are such uncomfortably large surpluses of wheat in some parts of the world. Fortunately for British farming, these are mainly located in dollar areas, and Canada seems to have set her face against the dumping of wheat, presumably because it will prejudice the future of the industry. It is unlikely that any country can produce cereals and land them in this country at a price with which our most efficient grain producers, who are applying all the modern techniques of tillage farming, could not compete.

Unfortunately, there are still too many farmers who have not realized the worth of their land for corn production now that we have improved varieties of cereals that will resist lodging and respond to heavier manuring. Some men have switched to the new varieties, but they have kept to their old levels

* Utilization of Grassland. R. A. HAMILTON. *Agriculture.* 1955, **62**, 375.

of fertilizer usage, with the net result that they are missing the extra 5 or 6 cwt. that really make corn production pay. It is an old saying that a laid crop breaks no man. It has a new force now that we have combine harvesters with pick-up attachments which make easy weather of laid crops. Especially is it important that really heavy crops are grown on small farms, for thereby the higher overheads of production can be spread more widely.

On the smaller mixed farm, the primary purpose of cereal production should not be a direct cash return, but a source of nutriment for stock. So often one hears complaints about the high costs of concentrates from farmers whose pasture lands are bright with buttercups in the spring and clamouring for the corrective attention of the plough. A tillage sequence is not only the right preparation for reseeding to a productive ley, but it provides starch equivalent in the form of cereals and forage crops much more cheaply than it can be purchased.

Grass saves Protein Despite what has been said before, there is one line of self-sufficiency that does *not* pay, except in exceptionally favourable circumstances, and that is the growing of protein-rich foods such as peas and beans, which are notoriously hazardous crops. Some men can make a good job of them but, with the great majority, a variety of factors, ranging from pigeons to Chocolate Spot, make peas or beans a very doubtful proposition. So far as dairy farmers are concerned, their best bet for protein is the provision of good grass over a long season and the making of really good hay and silage. For at least six months of the year, and a seventh in the more favourable districts, it is energy and not protein food that will limit the production of cows on good grass. In the winter months, 60 lb. of good silage can give protein for at least three gallons, though it may provide starch equivalent for only two. It is only when we come to the cow that is giving more than three gallons a day that a balanced dairy mixture, home-made rather than purchased, becomes necessary. Remember it is very much cheaper to buy groundnut cake as a straight than as a mixture, in which form it can also be fed too extravagantly.

So far as pigs and poultry are concerned, we are denied the protein-sparing function of grass and good silage, except that appreciable economies can be made in the feeding of breeding pigs by exploiting grazing. Here we have to rely mainly on purchased protein, which will be cheaper and more plentiful the less it is required for dairy cows. Though we haven't separated milk, as the Danes have, we are fortunate in that protein is a by-product of both our fishing and oil extraction industries. There would be no real shortage of protein if we were to use grass to the best advantage for our dairy cows; our dairy farmers should make the lot of the protein salesman a much harder one! Most pig and poultry farmers will, however, have to buy their protein supplements, but these should be bought as straights so that the appropriate meal mixtures are compounded on the farm.

It would, of course, be a tremendous advantage if we had separated milk. In its absence, we need something in the nature of national grain balancer meals for both pigs and poultry as a British answer to Danish separated milk, which constitutes a foolproof protein supplement. Fortunately, some firms are now providing such a supplement. Like Abou ben Adhem, may their tribe increase, for they are helping to put pig and poultry production on a firmer foundation for farmers who feed home-grown corn.

Long-term Confidence I am often asked about the long-term prospects of British agriculture. I cannot help but be confident about them if I am talking to a man who is prepared to farm his land as it

should be farmed. There are few countries in the world which have such a safe outlet for their farm produce as Britain. For the man who ranches his grassland, and depends mainly on someone else's acres for his quality feed, I am not so confident, for most surely such a man will fall by the wayside. Probably he will survive as long as commodity subsidies prevail, but by his own actions he is hastening their end, because he is helping to destroy their primary purpose—namely, the preserving of our balance of payments.

PROS AND CONS OF COWSHEDS AND MILKING PARLOURS

N. E. B. Elgar, F.L.A.S.
Woolcombe, Somerset

The yard and parlour can offer economies in time and labour, but it calls for good organization to avoid queues or idle machines at milking time.

DURING the past ten years many cowsheds have been built and many farmsteads altered or reconstructed to form yards for parlour milking. The tempo of building has automatically slowed down as capital has become scarcer and borrowing more expensive, so that there are still many farms which have not been re-equipped. The owners of these farms are naturally interested in the experiences of those who have modernized their holdings, and particularly in the pros and cons of the two distinct systems of cow-keeping. What has been learned during the last decade and what can be said for and against the two systems?

Several factors affect the choice, but in my opinion the most important is the type of land on which the farm is situated, the actual point at issue being whether or not the soil will poach in the winter months. A great deal of milk is produced on the heavier and wetter soils of this country, and under these conditions it is very important, especially on the smaller farms, that the cows be kept off the land during the winter months—say from December to the middle of April. This precaution clearly becomes increasingly important as the rate of stocking rises. As regular exercise is an important factor in keeping animals healthy, yarding is clearly advantageous in this case.

Parenthetically, however, it may be of interest to mention that William Harley—the great nineteenth-century Scottish businessman-farmer who kept his 100 cows tied by the head throughout their entire lactation—overcame the exercise problem by ensuring that all his cows were thoroughly groomed each day. But in those days labour did not cost a penny a minute!

Apart from this over-riding factor, the advantages and disadvantages of the two systems may be summarized as follows:

Cowsheds

For One of the main advantages of the cowshed, compared with the yard and parlour, is that it takes up less room—or, more accurately, the floor space required per animal is less. For example, a shed for 40 cows will cover about 210 sq. yards, whereas a yard for the same number will, together with the milking parlour, need about 490 sq. yards. This factor may clearly

be important where the farmstead is in a village with no room for expansion, and on farms in hilly districts where the amount of flat land is limited.

In cases where a breeder of pedigree cattle relies for a large part of his income upon sales of stock, he is, of necessity, interested in animals as individuals rather than as members of a herd. A cowshed is then more suitable for his needs, as undoubtedly it facilitates individual attention. A cow which needs special feeding, frequent grooming, or milking at different times to the rest of the herd, is much more easily dealt with if tied up in a cowshed than otherwise.

The prevention of outbreaks of disease is, of course, an ever-present consideration of the stock-owner, and one of the qualities which distinguishes a good herdsman from the not-so-good is the ability to forestall the onset of disease. An important sign upon which the experienced herdsman relies to warn him of any change in an animal's health is a change in the amount, texture or colour of the dung. This is a relatively easy matter in a cowshed but obviously much more difficult when the animal is loose in a yard.

Finally, where straw is difficult to obtain or unduly expensive, cowsheds have the advantage that the cows require appreciably less than they would if loose in yards. Further, alternative forms of litter, such as peat moss, wood shavings or sawdust, are more suitable for use in a cowshed than in a yard.

Against An important disadvantage of the cowshed is undoubtedly its lack of adaptability. In spite of urgently worded appeals to designers and manufacturers by the Engledow Committee on Farm Buildings (1942-45), no progress seems to have been made. In consequence, it remains one of the most specialized buildings on the farm and is still unnecessarily expensive to convert to other uses. Three things in particular make it so—the mangers, the stall divisions and the system of surface drainage. The mangers, consisting of specially shaped masses of masonry or concrete, are invariably built into the floor or wall, or both, and cannot be removed without damage to the fabric of the building. Similarly, the stall divisions, whether they are of steel or concrete, also form an integral part of the building. Some future designer may perhaps see fit to arrange things differently with, say, dismountable fittings screwed into cleats in the floor, and so increase the value of the cowshed as an adaptable farm building.

Whatever may be the relative cost of the two systems, a factor which is usually forgotten when making comparisons is the extent of the period during which the cowshed is put to full use. On most farms in the southern part of the country, full "board and lodging" is provided for not more than five months of the year. During the remaining seven months the building is seldom in use for more than three hours a day. That is to say, the capital locked up in the building is only fully employed for about half the year.

Labour is, of course, a vital factor in any discussion, and research carried out by Ford Sturrock at Cambridge has shown that the cowshed makes greater demands upon the labour force than the yard-and-parlour system. Cows milked by bucket plant in a cowshed required a yearly average of 182 man-hours per cow, compared with 139 man-hours for a herd milked with a releaser plant in a parlour. The extra 43 hours would today cost about £7, or, with a 30-cow herd, £210 a year. If the milking had been done with a direct-to-churn plant, the saving would undoubtedly have been greater.

It is undoubtedly easier to miss an animal that is bulling when she is tied up than when loose in a yard. The resulting loss of production is aggravated by the fact that in most herds the majority of services are planned to be made in the winter when the cows are lying in.

PROS AND CONS OF COWSHEDS AND MILKING PARLOURS

Milking Parlours and Yards

For It has been pointed out that a disadvantage of the cowshed system is that it requires more labour than the parlour. Apart from the saving in time, the cowman also uses up less energy under the parlour system than he would if using a bucket plant in a cowshed. In actual fact, the system imposes on him the need to think more and work less. To make full use of the machinery placed at his disposal, he must be strictly orderly in the sequence in which the various operations are performed. A proper system having been worked out, an intelligent man or girl can milk 35-40 cows single-handed without fatigue.

The capital invested in a milking parlour is relatively small in relation to the number of cows that can be milked in it—amounting to about £16-18 per cow for a 4-unit parlour capable of milking 60 cows. The capital invested in the yard is in direct proportion to the degree of cover provided for the cows. With the right aspect and a convenient layout of the existing buildings, the cost of simple lean-to buildings may be kept very low. On the other hand, a completely new building in an exposed position may perhaps cost almost as much as a cowshed. But whatever the cost, a great virtue of the yard is its adaptability to other uses during the summer months—a feature which the cowshed lacks.

It has already been explained that the yard-and-parlour system takes up more space than the cowshed. But it also offers more scope. Whereas a shed for 40 cows will house just that number and no more, time is the only limiting factor in the number of cows it may be possible to milk in a parlour. And a few extra cows can always be squeezed into a yard without too great inconvenience to the rest.

One of the advantages attributed to the cowshed is the possibility of economy in the use of straw or other litter. Whether or not this is an economy depends upon the outlook of the farmer and the class of land he farms. Many will undoubtedly maintain that the more straw trodden and the more dung carted out from the yards the better will be the crops and the more profit made. This outlook is obviously more likely to be found in districts where the soils are lighter and the land more hungry. To farmers on those soils, the dung-producing possibilities of the cattle yard must be a great attraction.

Against It is said that it is impossible to feed a full concentrate ration to a high-yielding cow during the time she is in the milking parlour. This is true when upwards of about 8 lb. are given at one feed, simply because it takes longer for the cow to eat her food than it takes to milk her. Cows frequently become restless when they have finished their food, and in extreme cases may even develop the habit of kicking off the teat-cup cluster. In many instances they find that restlessness pays, because the impatient cowman will give them a little more food to keep them quiet. Thus the vicious circle develops and becomes an established habit, which is difficult to eradicate, both with the animal and the man. The resultant waste of feedingstuffs may assume quite large proportions.

Both these criticisms may, however, be overcome if the milking parlour is used for milking only and the feeding is done separately, the cows being tied by yokes in the yards. The provision of some easy means of tying the cows, either by automatic or manually operated yokes will, in most cases, be regarded as an essential feature in feeding the bulk ration, and little extra labour is required if concentrates are to be fed as well.

Finally, a common criticism of the milking parlour is that it is a highly specialized building which does not lend itself to conversion to any other use. Doubtless this was true of the parlour built a few years ago, when the feet of the tubular ironwork were built into the floor and walls, but the same criticism does not necessarily apply today. Manufacturers are now using new methods of fixing so that the tubular ironwork can be bolted to cleats let into the concrete. This is extremely simple and makes for quick dismantling and re-erection. Incidentally, it is a development which should simplify the position as regards fixtures between landlord and tenant.

MECHANIZATION OF THE SMALL FARM

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The capital cost per acre of mechanizing the small farm is high. Therefore a good deal of care is necessary in selecting reliable machines which are not only suited to the conditions but which also have a certain degree of adaptability.

As agricultural labour becomes scarcer and dearer, mechanization must play an increasing part on all farms. Besides saving labour and increasing output per man-hour, there are many less obvious advantages in a high level of mechanization, the most important probably being that it enables operations to be carried out under the best conditions and keeps the farmer up with the calendar, even in difficult seasons. The economic application of machines is comparatively straightforward on large farms where the acreage of each crop is large enough to justify the purchase of specialized equipment. Adjustments can also be made in the size of various projects, some being omitted and others introduced to even out the labour demand and make the greatest possible use of a machine. The small farm, however, presents a much more difficult problem: and as four out of every five farms in Britain are less than 100 acres in extent, and since these small farms account for more than 30 per cent of the total acreage of crops and grass, their mechanisation is a matter of considerable importance.

On a typical small farm the workers have regular chores in connection with livestock and therefore need to get on with field work quickly in the limited time available. Low-powered small tractors and tools, designed primarily for the smaller market gardener, are not capable of the output necessary on a field scale. The small farmer's need, therefore, is for cheap equipment which will deal with his acres at normal farm rates.

Development of equipment specially suited to the needs of the small man has been slow, partly because of the problems involved and partly because of the gradual displacement of the horse. Few machines can be scaled down in size and price, and for many operations the demand in terms of power and capacity is the same no matter what the acreage to be dealt with. For example, a green-crop loader or a pick-up baler must take a full swath, and a sugar beet or potato harvester must deal with a full row.

Hitherto many smaller farmers have used horse equipment, or a combination of horse and tractor power; but this era of transition is coming to an end because both horses and machines are wearing out, and few horse

replacements are available. The question now is not *whether* to mechanize, but *how* to mechanize.

On a small mechanized farm the amount of capital per acre invested in machinery will inevitably be high, because the quantity of basic equipment needed for, say, a 60-acre farm, is usually adequate for one at least twice that size. Even the provision of the basic equipment is therefore costly, and the more specialized machines will have still higher charge rates against them. This high cost of mechanization can be met by a greater intensity of production where the quality of land and other physical factors permit, but on poorer lands there must be some limitation of equipment, probably some simplification of cropping, and the introduction of enterprises not dependent upon the land itself.

Suiting Machines to the Farm The choice of machines for a particular farm depends upon a number of factors, such as soil, climate and farming system, so that each farm must be dealt with separately. But there are some general principles which govern all. It is essential that the machine shall be capable of working efficiently under the particular conditions reigning. Its design and manufacture must ensure long life and it must be backed by an efficient servicing organization. Reliability is of paramount importance. Whenever possible, machines should be selected which, by addition or adaptation, can fulfil more than one purpose. Examples of this are a swath-turner and side-delivery rake, a tool-bar on which can be mounted in turn cultivator tines, ridging bodies, seeder-units, hoes and sugar beet lifting tines, and a potato harvester that can also lift sugar beet.

The machines chosen must form a matched set in themselves to ensure correct follow on, and must also match the tractor to enable the change-over from one machine to another to be made quickly. The tractor must be able to do the heaviest job on the farm, apart from special tasks where the timing is not critical and the job can be done more economically by a contractor.

The importance of one kind of equipment—transport—is frequently overlooked when considering mechanical needs. On most farms a third of the tractor's working time is spent on transport of one kind or another, and unless suitable vehicles are used the waste of power and time may be considerable. For the small farm, a tipping trailer is most desirable. To reduce the effort in loading, the body should be as low as possible, and it should be equipped with a stand so that the trailer can be hitched and unhitched when loaded.

Transport at the homestead, in the shape of pneumatic-tyred hand-trucks, light railways and overhead carriers, can often save a lot of labour, because, unlike most farm machinery, it may be used many times every day.

The improvement of the surface of roads and passage-ways around the farmstead by concreting enables rubber-tyred hand-trucks to be used extensively for carrying feed to livestock, and in recent years there has been a definite swing away from the use of the mono-rail towards the more flexible truck system. Where buildings are on sloping ground, food stores should be sited in such a way that all movement of fodder is downhill. If this is impracticable, self-propelled trucks enable feeding to be carried out quickly and with the minimum of effort.

Small farms differ considerably in respect of types of enterprises and also in intensity of production. Because they cannot readily be divided into groups according to the degree of mechanization best suited to them, it is probably most helpful to take an example at each end of the fertility scale.

MECHANIZATION OF THE SMALL FARM

On land capable of heavy yields of high quality, the level of mechanization must be correspondingly high to permit intensive production. The equipment must ensure that the crops are grown and harvested with the highest possible degree of efficiency. The importance of being up to date with the farming operations cannot be over-emphasized, and full advantage must always be taken of the ability of adequate (and frequently unavoidably excessive) mechanization to provide this timeliness.

Equipment for the Arable Farm A 60-acre farm on highly fertile land growing true farm crops might be farmed intensively on a six-course rotation, thus: one-year ley—potatoes—two cereal crops—sugar beet—cereals undersown with one-year ley. This would give 30 acres of cereals, 20 acres of potatoes and sugar beet, and 10 acres of ley. The first essential in dealing with such a set-up would be a medium-powered, four-wheeled, row-crop tractor equipped with pneumatic tyres and skeleton wheels. The tractor would need a hydraulic lift and three-point linkage. Secondly, a tool-bar, centre or rear, complete with cultivating tines, ridging bodies, seeder-units, hoes (including cross-blocking or down-the-row thinning equipment), and sugar beet lifting tines, would be called for. The rest of the machinery might be:

A two-furrow tractor plough, reversible semi-digger
Set of harrows, medium weight, four sections
Heavy Cambridge roller
Grain drill
Fertilizer distributor
Mower (5 ft. cut)
Combined side-delivery rake and swath-turner
Hay sweep, simple front-mounted
Binder
Potato lifter, spinner type, tractor-mounted
Two-wheeled, pneumatic-tyred tipping trailer

Bought new today, this equipment would cost approximately £1,600. But one item upon which a considerable saving could safely be made by buying secondhand is the binder: with the increase in the numbers of combine harvesters, there are many perfectly sound binders on the market at almost £200 below present-day new prices.

To be realistic, the depreciation on the equipment of a small farm must be based upon hours of use rather than on age, for if up-to-date, well-tried machinery is bought, the danger of obsolescence is negligible. It is therefore reasonable on a farm of 60 acres to assume a life of ten years for the tractor and fertilizer distributor, and twenty years for the rest of the equipment. If depreciation is calculated on a straight line basis, then the annual depreciation will be as follows:

	£
Tractor, £450 over 10 years	45
Fertilizer distributor, £70 over 10 years ...	7
Rest of equipment over 20 years	54
	106

The other fixed charge which must be taken into consideration is interest on capital, and it seems reasonable to make this 5 per cent on half the original investment. In the case under consideration, this would amount to £40, making the total fixed annual charge £146—that is, approximately £2 9*s.* per acre.

The remaining expenses—namely, repairs, maintenance and running costs—are almost the same per acre, whether the machinery is used on 60 acres

or on the maximum acreage which it could handle, which would probably be just three times as much.

On the basis of these figures a fairly accurate comparison of the cost of operating the same equipment on the small and larger farm can be made. Against the annual fixed charge on the 60-acre holding of £2 9*s*. per acre, on 180 acres it would be 16*s*. 4*d*. The small farm has therefore an extra machinery charge against it of about 32*s*. 8*d*. per acre. There is no doubt, however, that the higher intensity of production possible on the highly mechanized, fertile small farm can more than take care of the higher cost.

The Grass Farm At the other end of the fertility scale, where the farming is based on grass and forage and there are no direct sale crops, there is much less opportunity for the small farmer to boost his level of production above that of his neighbour with double or treble his acreage. The farmer on such a holding is faced with a problem to which there is no simple solution. He must either introduce extra enterprises, not dependent upon the land—so utilizing the time saved and yielding a sufficient profit to pay the charges of high mechanization—or his equipment must be kept to a minimum consistent with efficiency. In any case, on such farms the capital available is usually very limited, so there may be no choice.

By a mixture of old practice and modern machines the annual fixed charge per acre can, however, be kept within reasonable limits without sacrificing production. Thus for a 60-acre farm on the poorer land the following equipment is suggested:

Medium-powered wheeled tractor
Two-furrow, general-purpose plough
Set of dual-purpose flexible harrows
Set of light harrows
Heavy Cambridge roller
Mower
Fertilizer distributor, plate-and-flicker type mechanism
Combined side-delivery rake and swath turner
Buckrake, convertible to hay sweep
Pneumatic-tyred tipping trailer

With the general-purpose plough, a narrow furrow suitable for broadcasting can be turned, and the plate-and-flicker type manure distributor can apply the fertilizer, as well as broadcasting seed grain, forage crop seeds, grass seeds or powdered weedicides. Dual-purpose flexible harrows with sharp cutting blades on one side and arable-type tines on the other will work even very difficult land down to a fine tilth.

The cost today of the equipment listed above would be approximately £920, of which £480 would be written off over ten years and the remaining £440 over twenty years, giving a charge of £70 per year. To this must be added 5 per cent interest on half of the capital investment (£23), making a total annual fixed charge of £93, or 31*s*. per acre. This is almost 21*s*. per acre more than if the charge had been spread over 180 acres, and on farms in this low fertility category there is little chance of the small farmer making good the difference from the land itself.

There are, however, some compensations in this comparison with the larger farm to which a monetary value cannot be put. In the first instance the fact that the farm will inevitably be over-powered makes possible good work at all stages and at the most favourable time. The small farmer is also able to give the personal attention to care, maintenance and setting which will enable him to obtain the best work and longest life from his machinery. At the same time, he is able to achieve the maximum return from his land, and in this way he can justify the higher capital investment which has to be provided.

ARTIFICIAL INSEMINATION OF PIGS

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Three A.I. centres are already providing a service for pigs, and others are shortly to follow them. But there are a number of practical and technical difficulties to be overcome before a nation-wide service can be hoped for.

IT is only natural that, following the development of A.I. in cattle, interest should be aroused in the possibilities of its use for other farm animals. From the practical and economic points of view, the two species most likely to command attention are the pig and the sheep, in that order. The demand for A.I. in pigs obviously follows the same pattern as it did with cattle. At present the small man has to drive or transport his animals to a local boar for service—often a difficult and time-consuming job—and on this ground alone an A.I. service is probably warranted. With the development of virus pneumonia-free herds, this indiscriminate movement of animals is to be discouraged and, since it is believed to be impossible to transmit this disease by insemination, there is an added incentive to the provision of such a service.

However, the main purpose of artificial insemination must be livestock improvement, and with the experience of the early disappointment encountered in cattle A.I. very much in mind, it should be possible to benefit from those early mistakes and to develop a sound system ensuring improvement in the case of the pig. Fortunately, with such a quickly maturing animal one should not encounter anything like the same problems, provided adequate facilities are available for progeny testing. As far as possible, an effort must certainly be made to use only tested boars in A.I. centres, for even with present methods it might be possible for a boar to produce up to 20,000 offspring in a single year.

It is almost inevitable that the new Progeny Testing Stations shortly to be established will be unable to cope with demands from private breeders for at least the next five years, and consequently A.I. centres are initially going to be faced with the very difficult problem of obtaining suitable boars. Probably the answer will eventually be provided by centres setting up their own testing units. There would appear to be no inherent difficulty in such units operating on the same principle as the contemporary comparison method now used generally for cattle. This would iron out management factors and, if the boars were tested in groups, their progeny could be compared under identical conditions. It would then be possible to retain the best animal from each group and use him heavily for A.I., while at the same time breeding one or two sons from selected sows for putting through the testing process. It might also be necessary, as in the case of cattle, to carry out a number of inbred matings from tested boars to detect possible recessives.

After a number of years it should be possible to select from within the tested boars outstanding animals on which to concentrate the breeding programme, although some care would have to be exercised in avoiding too close inbreeding. All this would take time and, in the meantime, it is hoped that all possible help in finding suitable sires will be given by the N.P.B.A., who have so far shown an extremely realistic attitude to possible developments.

Technical Difficulties From the technical point of view, A.I. in pigs is very much in its infancy, and the problems facing scientists developing the techniques are much more difficult and complicated than those met in the early development of A.I. in cattle. The collection of the semen itself presents no great difficulty; the boar can readily be trained to mount a dummy sow. This commonly consists of a metal framework, or even a log of wood, padded with straw and canvas. Once trained to this dummy, boars work extremely well. The artificial vagina used is similar to that used for the bull, but modified to provide a pulsating mechanism and provided with a much larger semen receptacle.

The boar produces about 250 c.c. of semen, which is less dense than that of the bull and contains globules of a peculiar jelly-like substance, the function of which is not known for certain but is thought to provide a vaginal plug to prevent the semen from escaping. Boar semen will not store for more than a few hours under normal conditions, and it was not until the advent of the glycine diluent that storage became possible. More recently it has been found that quite good storage can be obtained in heat-treated, powdered skimmed milk.

Having collected the semen, the jelly is removed by sieving through muslin; if this were not done the rapid expansion of the jelly which occurs in water would block all the equipment used for insemination. The jelly is freeze-dried and reincorporated in the dilutor in a less concentrated form. Dilution is either carried out with milk or with a 2 per cent glycine solution containing 30 per cent egg yolk. Dilutions of up to 1 in 10 are used and the mixture is cooled in the refrigerator to +5°C. until used.

The insemination itself is carried out by pumping 100 c.c. of this mixture through a stiff rubber catheter into the vagina of the sow. The optimum dosage of semen is not yet known, and experiments are being carried out to determine this, but inseminations are performed on the second day of heat, as it is known that the sow ovulates at about 40 hours from the start of oestrus.

Even with the development of these dilutors, it has been found that the fertility of boar semen falls off rapidly in storage, and results with second-day semen are only a little more than half as good as those obtained when used on the day of collection. This, in itself, presents a problem in that it becomes necessary to provide a daily supply of fresh semen, and distribution through a sub-station system becomes complicated and difficult. Attempts to overcome this by deep-freezing the semen have so far not been very successful, although this is the obvious answer to the problem. Efforts are still being made to develop a suitable technique, but whether this will be possible remains to be seen.

Strangely enough, the major problem in the application of artificial insemination to pigs is not technical at all; it is the inability of many small pig-keepers to decide when their sows or gilts are actually on heat. This has resulted in a marked division of pig herds into those which have had good results with A.I. and those whose results have been extremely bad.

Results so far indicate that the conception rate could be improved from its present level of 50-60 per cent in pig to the first service, but it is felt that much of the difficulty here is, as already explained, of a non-technical nature. In contrast with conception rates, the litter size has generally been good, the average at Cambridge being 10.9, including both sows and gilts.

From a very small beginning, the artificial insemination of cattle developed extremely quickly over a period of ten years, until more than half the cows in the country are now being inseminated. It is virtually certain, however,

that in the light of present knowledge no such quick expansion will take place with pigs. It will probably be necessary to carry out field experiments for a number of years before all the various faults of the technique are cleared up and the way opened for the provision of a nation-wide service.

Few Breeds and Tested Sires Three A.I. centres are, however, already providing a service, and three others will be doing so within the next month or two. So far, the M.M.B. centres have not begun operations, but are obviously interested in doing so and will probably follow suit later on. Of the three non-Board centres which have already made a start, two are using Large White boars and one Landrace. It is believed that the other private centres about to start will use Large White boars initially.

The question of the breeds of boars to be housed at A.I. centres is one which, in the light of recent recommendations, requires a certain amount of thought. If service is to be given from many breeds the chances of concentrating on progeny-tested sires is going to be reduced and a hotchpotch of offspring from every conceivable cross is going to result. This would appear to be undesirable, and it would probably be better for centres to concentrate on a certain breed or breeds and do everything possible to obtain suitable boars from within these breeds. It is inevitable, however, that some members of A.I. organizations will exert pressure on management committees to provide a service from what one might call "minority breeds". And such pressure will undoubtedly be difficult to resist, since it is often much more difficult for such owners to have their sows served by a boar of the same breed without moving the animal a long way.

Provided suitable sires can be found, the provision of such a service is reasonable, but it should not interfere with the policy of concentrating on certain breeds and the use of tested sires. It would be an almost impossible task for any A.I. centre to provide facilities for testing groups of boars from several breeds, and unless emphasis is laid very strongly on one or two breeds, a dilution of effort will result in very little progress. To compare figures nationally, a standard system of housing, feeding and management is obviously desirable, but whether such standardization is possible in practice in widely scattered units is a little doubtful. This should in no way affect the value of testing within a single unit where management fluctuations are equally spread among all groups.

Turning to administration, there is at the moment no direct control over the artificial insemination of pigs, other than health requirements where the boars are housed at A.I. centres, but obviously some form of control is desirable and no doubt will be brought into force as the technique develops. The obvious solution would be to bring in regulations to cover the provision and distribution of semen in exactly the same way as with cattle. The same inseminators are carrying out both processes, and to establish separate control would be both difficult and cumbersome.

British Weed Control Conference, 1956

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NORBRECK HYDRO, BLACKPOOL

Further details may be obtained from Mr. W. A. Williams, British Weed Control Council, Cecil Chambers, 86 Strand, London, W.C.2.

MCPA FOR THE CONTROL OF WEEDS IN SPRING OATS

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Experiments conducted by the Agricultural Research Council and the N.A.A.S. have shown the major importance of correct timing of the spray.

In England and Wales each year about a million acres of land are sown with spring oats, a considerable proportion of it being on dairy and livestock rearing farms, where the oat crop is the most important, and sometimes the only, cereal crop grown. Already the use of chemical weed-killers is an accepted part of cereal crop husbandry, and each year more acres are being sprayed. One of the restrictions in spraying weeds in spring corn is that the operation must be carried out during the time that is safe for the crop, even though this may not coincide with the best time for killing the weeds. By 1950 it was known that the safe period for treating spring cereals with the growth-regulating substances MCPA and 2,4-D was between the completion of tillering and the start of shooting; but little precise information was available concerning the inadvisability of spraying outside this period. The new developments discussed here are concerned with the extension of the safe period for the control of weeds in spring oats and the need for the correct timing of the spray in relation to the stage of growth of the weeds.

To obtain more experience of the response of spring cereals to spraying at different stages of growth, the Agricultural Research Council's Unit of Experimental Agronomy, in co-operation with the National Agricultural Advisory Service, carried out a programme of field experiments between 1951 and 1955 on spring wheat, barley and oats, in which MCPA and 2,4-D were applied over the range of stages between emergence and shooting. This article is concerned with one part of the investigation—the results of applying MCPA to spring oats. The second weed-killer—2,4-D—is not recommended for application to spring oats and is therefore not discussed.

Two-part Investigation All the experiments were carried out on ordinary farm crops. In the first part of the investigation, which lasted for three years, the experiments were on weed-free crops so that the direct effect of the chemical on the crop could be measured. The detailed results, which have been reported elsewhere [1], included observations on the growth of the oats, as well as measurements of grain yield, dry matter content, nitrogen content, seed weight and percentage germination.

The tests and observations showed that no serious damage resulted from applications of up to 2 lb. MCPA (sodium) per acre. The chemical was not, however, completely without effect. Occasional deformed heads were observed, but the deformity was mild and amounted to not more than one in ten at the 2 lb. per acre dose. This treatment also slightly checked the growth of the oats, resulting in a reduction in yield of about 6 per cent in a weed-free crop and a small increase in nitrogen content. These effects were obtained equally, irrespective of the different times of application, including

the known safe period between tillering and shooting. The conclusion from the three years work was that the spraying of spring oats with up to 2 lb. of MCPA (sodium) per acre in a low-volume solution would be safe if the application was made at any stage of growth between the expansion of the first leaf and the beginning of shooting—usually when the plants had about seven leaves on the main stem.

In view of the existing knowledge that annual weeds susceptible to MCPA were most easily killed at the young seedling stage, it was decided that the next part of the investigation should involve experiments on weed-infested fields to obtain information on the practical effects of spraying at different times during the early stages of crop growth. Early spraying when the oat plants had one to four leaves was compared with applications made in the post-tillering period, when there were six leaves on the main stem. The effect on a number of different weeds can be seen in Table 1. At the early spraying most of the weeds were seedlings (cotyledon—four leaves), and at the later spraying they varied, according to habit of growth, between four and twelve inches high. For the purposes of comparison, points were awarded (with a maximum of 10) to indicate the degree of susceptibility of the weeds.

The results show that for equivalent doses of chemical the earlier application gave superior weed control. The outstanding treatment—1½ lb. MCPA (sodium or potassium) per acre applied early—gave a satisfactory control of speedwell, spurrey, fat-hen and heart's-ease, and a fairly successful control of knotgrass, redshank and chickweed.

Table 1

Effect of Spraying Weeds with MCPA at Different Stages of Growth

(Means for each treatment. 1954 and 1955 experiments combined)

No. of Experiments	Species	Early Spraying (Oats 1-4 leaf stage)		Normal Spraying (Oats 6-7 leaf stage)	
		lb./acre MCPA 0.75	1.5	lb./acre MCPA 0.75	1.5
3	Chickweed (*Stellaria media*)	3	6	2	2
3	Fat-hen (*Chenopodium album*)	8	9	6	8
1	Heart's-ease (*Viola tricolor*)	7	9	2	4
3	Knotgrass (*Polygonum aviculare*)	5	7	3	4
3	Redshank (*Polygonum persicaria*)	5	6	2	4
2	Speedwell (*Veronica* sp.)	6	8	4	4
3	Spurrey (*Spergula arvensis*)	6	8	4	5

The method of scoring was by eye on each plot as follows:

0 = no effect
2 = slight check
4 = severe check but no mortality
6 = severe check and 50 per cent kill
8 = severe check and 75 per cent kill
10 = 100 per cent kill

In considering the figures above, it must be borne in mind that speedwell, knotgrass, and chickweed are usually classified as moderately resistant to MCPA at all growth stages, while spurrey and redshank are susceptible only when seedlings (²).

Effect on Yield of Oats The response of the crop to the removal of weeds differed in 1954 and 1955. In 1954 successful weed control at either time of application did not increase yield; in 1955 there were substantial increases in yield. The difference in the weather of the two seasons may provide an explanation. The spring and summer of 1954 were mainly cool, damp and not very sunny, whereas in the following year, a normal spring was followed by a hot, dry summer. In 1955, eight oat crops were sprayed, and in six of these early spraying gave satisfactory weed control. The other two trials were unsatisfactory, one because the field contained a late-emerging infestation of creeping thistle (*Cirsium arvense*), and the other because after early spraying a second germination of redshank occurred. In neither of these two experiments was there any significant difference in crop yield. In the other six experiments, the mean results of which are shown in Table 2, early spraying resulted in higher yields than did normal spraying.

Table 2

Yields of Sprayed Oat Crops, 1955

(Means for each treatment of six experiments of similar design)

	Control (Unsprayed)	Early Spraying (Oats 1-4 leaf stage)		Normal Spraying (Oats 6-7 leaf stage)	
		lb./acre MCPA (potassium)		lb./acre MCPA (potassium)	
		0.75	1.5	0.75	1.5
Yield (*cwt./acre*)	25.3	30.7	30.8	27.0	26.3
Yield as percentage of unsprayed control ...	100	121	122	107	104

Conclusions Summing up the results of the fifty-six field experiments on spring oats over the past five years, three main points have emerged:

1. MCPA, either as the sodium or potassium salt, at the rate of 2 lb. per acre, had little effect on spring oats when applied during the period between the expansion of the first leaf and the beginning of shooting.
2. Annual weeds, including some classified as moderately resistant to MCPA, were controlled more successfully in the young seedling stage than when they were three or four weeks older.
3. In the 1954 experiments, successful weed control at either time of application did not increase yields; but in the 1955 experiments, the earlier control of weeds resulted in greater yields.

It is emphasized that these experiments were carried out with the sodium and potassium salts of MCPA as low-volume solutions in water containing no wetting agents. The results would not necessarily apply to the use of other formulations of MCPA.

Spring weather varies from year to year; because of this the time of annual weed emergence relative to the growth of the oat crop is not constant. In some years the oats may reach the three-leaf stage of growth and still appear quite clean; in other years the crop will be infested with seedlings of annual weeds before reaching the two-leaf stage. In consequence, it is important that the correct time to spray should be judged according to the density and age of the weed population. From past experience, coupled with a knowledge of the prevailing weather conditions, farmers should be able to forecast

whether the weed population in any particular field constitutes the main "flush" of weed emergence. Once most of the plants of the main "flush" have formed two true leaves, the spraying of MCPA should not be delayed. Here a word of caution is necessary. Some soils have a capacity for repeated weed germination in spring, and when spraying oat crops on these soils the weather is an important factor. If cool, dry weather at the time of corn emergence is followed by damp, warm conditions, a substantial germination of annual weeds will probably take place. On such soils care must be taken to ensure that spraying is not done before the main "flush" has emerged.

Where an infestation of a perennial weed like creeping thistle is expected, the time of application cannot be judged only by the growth of the annual weeds present, and spraying may have to be delayed until after the shoots of the perennial weed have emerged.

Experience in this series of experiments suggests that the greatest economic benefits of spraying spring oats will be obtained only if careful attention is given to the timing of the application. This article has attempted both to define the safe limits of using MCPA and to indicate some of the many factors involved in the correct timing of the operation, but the final judge of when to spray must be the farmer with his local knowledge of soil and weeds.

ACKNOWLEDGMENTS

The experiments reported in this article were part of a programme of co-operative work on the field testing of weed-killers, undertaken by the National Agricultural Advisory Service and the Agricultural Research Council Unit of Experimental Agronomy. Acknowledgment is made to the many N.A.A.S. officers who carried out the field work and the tests on the grain, and, in particular, to P. Jamieson (N.A.A.S.), who took a leading part in the field work. Thanks are also due to the many farmers who made the fields available for the experiments and provided combines for the harvesting of the plots.

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1. J. D. FRYER. *Proc. Brit. Weed Control Conference, 1953.* 39-43.
2. *Weed Control Handbook, 1956.* British Weed Control Council. (See note on p. 601.)

Owing to the printing trades dispute, it is regretted that the production of this issue has been slightly delayed.

Some Articles of Outstanding Interest

● **NEXT MONTH** ●

Silage in the Economy of the Farm	*by* H. T. WILLIAMS
Profit Margins on a Small Dairy Farm	*by* H. E. EVANS, D. T. EVANS and E. M. THOMAS
The Story of Holkham	*by* C. W. ROWELL
The Cultivation of Winter Rape as an Oil Seed Crop	*by* E. S. BUNTING
Myxomatosis and the Balance of Nature	*by* H. N. SOUTHERN

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UPLAND FARMING AND THE LIVESTOCK REARING ACT

PROFESSOR W. ELLISON, B.SC., PH.D.
University College of Wales

Thanks to the help provided by the Hill Farming and Livestock Rearing Acts, 40 per cent of the upland farmers of England and Wales eligible for assistance have prepared comprehensive improvement schemes, which eventually must be reflected in increased profits. But what of the other 60 per cent?

THE upland farms referred to in this article are those on which the farmer derives the major part of his gross income from the sale of store sheep and cattle. This does not preclude the receipt of some income from the sale of milk, eggs or pigs, or even fat sheep and cattle, but livestock rearing will normally be the predominant enterprise on the farm. This in fact must be the case if such a farm is to qualify for benefits under the Hill Farming and Livestock Rearing Acts. Under these Acts, the owners and occupiers of eligible farms can receive 50 per cent grants towards the capital cost of carrying out a very wide range of improvements to a very wide range of items, provided the scheme of work has been formally approved by the appropriate department of the Ministry of Agriculture. The purpose of these Acts is to assist farmers and landlords in the costly task of rehabilitating farms of this type in order to increase production and to make them more efficient and productive units.

Before the Second World War this class of farm, perhaps more than any other, had suffered from the prolonged effects of the agricultural depression which developed in this country towards the end of the last century and was only temporarily alleviated during and immediately after the First World War. Even with the advent of guaranteed prices and markets after 1940, economic conditions were not greatly improved for these farmers, since official Government policy during the war was aimed at discouraging the production of fat sheep and cattle in deference to milk and arable crops.

While many upland farmers were able to change over to milk production and take advantage of the better prices and the monthly cheque, others, for a variety of reasons, had to continue with their traditional system of farming in spite of rising wages and other costs. Consequently, after the end of hostilities these farms were still in a relatively depressed and unproductive state and not in a position to meet the increasing demands for more store sheep and cattle for the lowland farmer to fatten into home-produced beef, mutton and lamb. Even though prices for store stock began to rise sharply, it was realized that shortage of capital was likely to be a serious limiting factor in carrying out the many improvements that were necessary if these farms were to show any marked increase in production. Thus the Hill Farming Act was passed to meet this need.

Basically, the upland farmer's problem, like that of any farmer, is to increase his net income so as to provide himself and his family with a better standard of living. Various economic surveys have shown that on most of these farms there is little scope for increasing net income by cutting costs, especially as many of the farms are small, often totalling less than 150 acres, of which as much as one-third may be rough grazing. A recent survey [1] has shown that the average size of farm in England and Wales eligible for

assistance under the Hill Farming and Livestock Rearing Acts is just ovet 300 acres, of which only about 100 acres is enclosed land. These acreages are considerably less than those suggested by the Welsh Land Sub-Commission (²) as being an economic size under these conditions; namely, 100-150 acres with 500 acres of rough grazing land for a hill farm, and 200 acres of medium quality enclosed land for a livestock rearing farm. The broad problem on most of these farms today is, therefore, one of increasing net income through greater and more economic production as a result of carrying out improvements to land, stock, buildings and other facilities.

Better Grass for Old Since most upland livestock rearing farms are in the higher rainfall areas, grass is the predominant crop. On the majority of these farms, however, even grass production is much lower than it could be, partly because of the poor type of existing herbage and partly because not nearly enough lime and fertilizers are used to offset the poor inherent fertility of these soils.

Research, which has been carried out at various centres in this country during the last fifty years, has shown quite clearly that grass production, under these conditions, can be greatly increased by several methods. The chief difference between these methods is the rate at which improvement can be brought about and the initial cost of the work. Reseeding, for example, requires a greater initial capital outlay but, if successful, gives a quick and marked response. Treatment with lime and fertilizers involves much less capital at any given time and generally results in a relatively slow rate of improvement. It is unfortunate that these two methods are frequently regarded as alternatives, whereas, in fact, on most farms they can be complementary to each other, especially where the ploughing of old grass is a practicable and economic proposition. There are, of course, other areas where the use of lime and fertilizers may be the only feasible method because of the steepness, stoniness or inaccessibility of the land.

Direct reseeding without a cover crop can give excellent results, but it is a costly method of improvement, best suited to the farmer who is a sound and experienced husbandryman with adequate financial resources to meet not only the cost of the work, but also the cost of any extra stock that may be required. Other methods of reseeding, such as with a cover crop of rape, or even with a cereal crop, can give even relatively quicker financial returns and thereby reduce the cost to be charged to the new sward; but in some cases the ultimate success of the new sward may be jeopardized. On the other hand, many farmers have used these methods with great success. As in so many things in farming, it is the farmer as a husbandryman who matters most in relation to the success or failure of whatever is being done.

In the case of the soils of relatively poor inherent fertility, a succession of forage crops, such as rape, may be essential for the successful establishment of a new sward. This method may be especially appropriate on the wetter soils where rushes are likely to become a problem. A large proportion of the rush seeds already in the land can be encouraged to germinate and the seedlings then killed, while in a young and delicate state, by the cultivations to be carried out for the next green crop. On the better land of the enclosed fields, it may be an advantage to take the land through a rotation before laying it down to grass.

Help with Winter Feeding These variations in the methods that can be adopted to get new and better grass for old can also be used to help in solving the winter feeding problem that exists on most of these farms. It is an over-simplification of the problem to say that

more and better grass will aggravate the existing difficulty of too much grass in the summer and too little stock food in the winter. This state of affairs undoubtedly exists on many upland farms, but, as a first step in securing a better balance between winter and summer food supplies, improvement of the grassland should provide grazing for the same head of stock from less land, so that the farmer has greater flexibility of use with the remaining acreage of land. This can then be used to grow more grass for hay, silage or foggage, or it can be ploughed up for cereals, roots or forage crops. Young pastures, properly fertilized, can also help to solve the winter feeding problem by lengthening the grazing season. Forage crops, such as rape, kale and Italian ryegrass, can often be used very profitably to shorten the difficult winter feeding period. It is up to the farmer, however, to decide how these various methods can best be adopted and integrated to suit the conditions of his particular farm.

All these methods will, of course, eventually require the investment of considerable extra capital if any marked degree of improvement is to be achieved. It was shown in a recent survey, for example, that the average cost of improving production from the land to carry the equivalent of an additional mature animal was as much as £55 per beast, excluding the cost of the beast itself. In the case of reseeding, an average expenditure of just over £20 per acre gave an average increased stock-carrying expenditure of rather less than half a cattle beast per acre. Although improvement with lime and fertilizers cost only about one-third as much, the increase in stock-carrying capacity was proportionately less, and the total cost per additional mature beast equivalent was therefore approximately the same in both cases.

It is fortunate that the cost of most of this kind of work can qualify for a 50 per cent grant under the Hill Farming and Livestock Rearing Acts and that the actual carrying out of the work can be spread over a number of years to suit the farmer's pocket and other resources.

In schemes so far submitted in England and Wales, the proposed expenditure on improvements to the land, including ditching, fencing and drainage, amounts to just over £2 per acre over the total area of the farm.

Quality Counts As implied above, greater financial returns could be obtained on many of these farms by improving the quality of the existing stock through better feeding, especially in the winter, rather than by attempting to carry more stock. One of the chief aspects of the winter feeding problem is to provide enough good quality, high protein foods, especially for young stock. This need can be partly met by conserving more of the better quality grass from improved pastures in the form of hay and silage, as well as by an extension of the grazing season in both spring and autumn.

Another method of dealing with the same problem, especially as far as cattle are concerned, is to dispose of more young stock to lowland farmers in the autumn. This can be done very successfully if the calves are born early in the year and are well grown and in good condition by the autumn, when they can be sold as "suckers". This has long been established practice in the North of England, and although inevitably the term "suckers" has not passed unnoticed by the wags(!), there is a very good trade in this class of stock. It is also encouraging to note that this practice has been extended to other parts of the country in recent years. The numbers of "suckers" entered for organized sales in the Brecon area has continued to increase steadily since the sales were started a few years ago. Farmers are beginning to realize the importance of quality rather than quantity in securing a better

total net income. This system also saves labour, which is becoming an ever-increasing problem in many of these areas.

If more beef calves are to come from dairy herds and are to be reared by upland farmers, who traditionally buy the extra calves they need from lowland farmers, then there is much to be said for the growing practice of calving down more of their cows in the autumn, when other calves are generally cheaper to buy than in the spring. Such calves can also go out to grass in the following summer and may then be sold off in the autumn, thus again helping to reduce the winter feeding problem.

There is no doubt that on many upland farms much of the extra stock which can be carried after improving production from the land should be cattle rather than sheep, since more cattle on these farms can help to ensure a longer and more productive life for the new swards.

Extra cattle may raise the question of building accommodation for them, but 50 per cent grants are also available to meet the cost of renovating or enlarging existing buildings and towards the cost of cattle sheds for outlying hardy types of cattle. The estimated expenditure on buildings for schemes already approved in England and Wales is about £1 10*s*. per acre over the whole farm and is nearly three-quarters of the amount to be spent on improvements to the land.

On many lower-lying farms, poultry and pigs could play a greater part in augmenting the gross income for a relatively small capital outlay.

The Human Equation Living conditions for the farmer, the farm worker and the families of both are likely to play a very important part in the future development of these areas, as they have done in the recent past. Human settlement must centre around the womenfolk. And the wives of the younger farmers and farm workers are becoming more exacting in their demands than were either their mothers or their grandmothers. The response of the menfolk is reflected in the relatively high proportion of money which is earmarked to be spent on improvements to houses, cottages, water and electricity supplies and roads. This amounts to nearly £3 per acre, or 45 per cent of the total cost of the average approved scheme, and also indicates the degree of dilapidation which exists on these farms in terms of the requirements of present-day farming.

Provided there is reasonable prospect of the holding becoming an economic unit after rehabilitation, then these schemes will ultimately represent money well spent. Both the farmer and the nation, however, must realize that nearly half the money to be spent on schemes already approved is unlikely to have any immediate influence on current production from these farms and must be set against the rather nebulous term of "social improvements", which will no doubt have a long-term effect on the broader problem of rural depopulation.

Many factors influencing the drift of both farming families and farm workers from these areas are beyond the control of the farmers themselves. The closing of village schools, for example, has had serious repercussions on younger married people in some areas.

The existence of unadopted roads has also presented serious if not impossible difficulties to some farmers who were anxious to improve their holdings but saw little point in doing so while the means of access was beyond their financial resources or responsibilities. The Agriculture (Improvement of Roads) Act, 1955, which provides £4 million in grants towards the cost of improving such roads, will be of considerable assistance to many farmers.

The relatively isolated situation of many of these farms has been a serious handicap in getting contractors to carry out the work of approved schemes. This, and the more general problem of lack of capital, are probably two of the principal factors responsible for the slow progress with schemes long after they have been approved. The survey mentioned earlier showed that farmers in general tended to carry out improvements to the land before starting on the more expensive project of improving fixed equipment. This may be partly due to the fact that they could do the work themselves, but also partly because improvements to the land resulted in a direct increase of income and the return of capital which could be "ploughed back" into further improvements. This would seem to be a wise course on the part of the farmer, as the evidence available indicates that the percentage return on capital invested in a completed scheme will be greater in relation to the money spent on improvements to the land than on the expenditure in fixed equipment.

The Opportunity According to present arrangements, the Hill Farming and Livestock Rearing Acts are due to expire in November 1956, and no more schemes can be accepted after that date. No time limit has, however, been set for the completion of schemes which have been approved before the expiry date. So far, something like 40 per cent of the estimated number of eligible farmers in England and Wales have submitted schemes. This does not mean that the remaining 60 per cent ought to do so. There are, undoubtedly some farmers who have no need of a comprehensive scheme. There must be many, too, who occupy holdings which, because of their size or some other factor, are never likely to become economic. There may also be some occupiers who are not suited to undertake costly schemes of work—those whom many economists refer to as "marginal farmers", in contrast to marginal farms. These latter two groups of holding may well one day become consolidated into larger units around holdings that have already been improved. How and when this will come about belongs to the future.

There must, however, be some of the 60 per cent who have not yet submitted schemes that could well do so, and it is up to them to help in showing the Government what real need there still is for the Hill Farming and Livestock Rearing Acts to be extended in terms of time and money. These Acts undoubtedly offer the hill and upland farms of this country a unique opportunity to rehabilitate their homes and holdings, and it would be a tragedy if their advantages were not realized to the full, especially when there is such a ready market for store sheep and cattle and a national need for more beef, mutton and lamb—at the right price!

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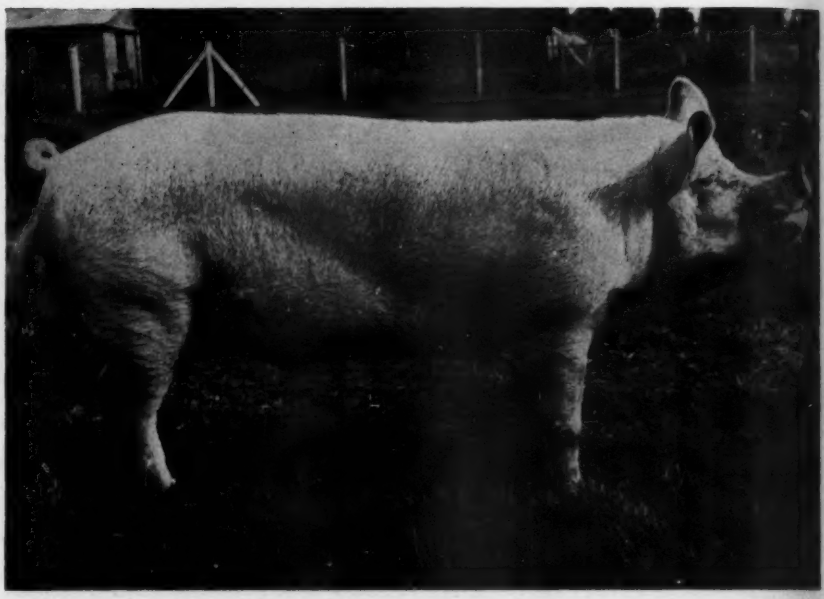
"AGRICULTURE" INDEX

The Index to Volume LXII will be issued with the April number.

Photo: *Topical Press*

Upland grazing in the Vale of St. John, Cumberland.

Artificial Insemination of Pigs (Article on pp. 571-3)



SHEFFORD ROYAL MONARCH. First boar to be used for artificial insemination at the Cambridge centre . . .

Photos: *H. J. Ballinger*

. . . and his first litter.

Low Volume Spraying of Fruit and Hops (Article on pp. 583-6)

Conventional high-volume hop washer.

Photos: *Plant Protection*

Man-directed mist-blower.

Photo: *Sweatman Hedgeland*

Low Volume Spraying.

Air-blast machine with fan driven from tractor power take-off.

LOW VOLUME SPRAYING OF FRUIT AND HOPS

E. HOLMES, PHD., F.R.I.C.
Technical Director, Plant Protection Ltd.

Low volume spraying in orchards and hop gardens saves chemicals, labour and tractor operating costs. Several suitable kinds of sprayer are on the market, including small machines for the grower who hasn't a lot of money to spare.

LAST month a comparison was made between high- and low-volume agricultural spraying, indicating that both are needed for specific jobs. Interest in this country in low-volume application of sprays to top fruits and hops arose several years after the introduction of the first low-volume agricultural sprayer, although in the U.S.A. and in Holland concentrate spraying had been practised for several seasons, especially on apples. Until the introduction of a spring spraying programme for top fruits, large volumes of winter washes were needed for the control via the eggs of aphids and sucker, and of winter moths and other pests during the dormant season. These could not be applied in highly concentrated form and low-volume spraying was not therefore practicable.

High-volume fruit and hop spraying uses much greater quantities of water than agricultural spraying. High-volume fruit spraying usually means the application of anything from 200 to 500 gallons of spray per acre, depending upon the size and spacing of the trees; for hops, between 150 and 250 gallons per acre are used.

Considerations for Hops A hop sprayer must, of necessity, be narrow so that it can travel down the alleys without damaging the bines, and it must not be too long if it is to be skilfully turned at the narrow headlands. Large tank capacities are out of the question, and one acre (sometimes less) for each filling of the sprayer tank is the most that can in general be hoped for with high-volume spraying. Because of the demand from several growers to speed up their spraying, experiments with lower application rates of spray were started by my colleagues, Mr. J. H. Stapley and Mr. F. W. J. Lane.

The first machines to be used were two modified agricultural sprayers, first, one using an air-blast and, second, a low-volume hydraulic unit. Neither machine was very satisfactory because the booms tangled with the hop bines and damaged them, and the spray distribution was far from good. The air-blast machine gave the better results, and a new automatic machine of this kind was accordingly designed for subsequent experiments.

Spray distribution with the new machine was at least equal to that obtained with the conventional high-volume sprayer, and the chemical was retained better on the foliage. An application rate of 25 gallons per acre enabled between 6 and 7 acres to be sprayed for each tank filling.

Using 25 gallons of spray per acre for early application and 35 gallons later, copper and sulphur gave control of Downy and Powdery Mildew. Similarly, parathion and systemic insecticides such as demeton gave control of aphids and Red Spider at least equal to that obtained with the same amount of chemical applied in 150-200 gallons of water per acre. Low-volume application of insecticides and fungicides to control pests and diseases in hops is now practised by an increasing number of growers, and there are at least two satisfactory low-volume hop sprayers on the market.

LOW VOLUME SPRAYING OF FRUIT AND HOPS

The following table gives details of a low-volume hop spraying programme:

Pest or Disease	Product	Rate per Acre
Aphid and Red Spider	Demeton (50%)	5 fl. oz.
" "	Parathion (20%)	10 fl. oz.
Eggs and young mites of Red Spider	CPCBS (50%)	2¼ lb.
Downy Mildew	Cuprous oxide (50% Cu)	4 lb.
Powdery Mildew	Dispersible sulphur (75%)	8-10 lb.

More recent experiments have been carried out using wide-angle jets fitted to the back of conventional high-volume hop washers. No air-blast is used; spray is pumped to the jets at pressures from 80 to 100 lb. per sq. inch. Spray application rates are higher than with the air-blast machine, in order to obtain the necessary penetration and carry from the jets; between 60 and 70 gallons per acre are used. The experiments are not yet complete, but if they are successful, then the higher application rate will be offset by the fact that a grower will be able to convert his conventional high-volume sprayer to apply low volumes for very little extra cost.

Differing Requirements of Hops and Fruit In spite of the fact that many machines are referred to as hop and fruit sprayers, a combination of these two functions is by no means always successful. These are two distinctly different jobs. Hops are planted more closely together than fruit trees. There is not the same depth of foliage to penetrate with the hop as with the fruit tree, and more often than not the latter are a lot higher. With fruit, therefore, more power is generally required to carry the spray, and the same machine will seldom be capable of doing two jobs. As an example, the Hopblast, a very good hop sprayer, is not powerful enough for most fruit spraying. On the other hand, the Autoblast Nos. 2 and 3 have the necessary power and lend themselves very readily both to high- and low-volume fruit spraying.

The initial spray application rate for top fruit was quite arbitrarily fixed at 50 gallons per acre. This rate was used throughout the experimental programmes and is still the most widely used by growers.

A simple modification to the Autoblast, consisting of blanking off all but sixteen of the standard jets and replacing them by No. 4 Bray jets fitted with filters, is all that is necessary to convert them to low-volume sprayers. An application rate of 50 gallons per acre can be achieved with this machine at a forward speed of 2-2½ m.p.h. The speed of travel is of the greatest importance; slower speeds lead to tree wetting by the spray—much faster speeds preclude satisfactory coverage.

Low-volume spraying, particularly of apples to control scab and insect pests, is now an established fact, using no more than 50 gallons of spray per acre. While it is not, perhaps, as widely accepted among fruit growers as its agricultural counterpart is among farmers, more growers are becoming interested every year.

It should be made clear that low-volume is not necessarily easier than high-volume application, for it requires greater attention to detail. The importance of maintaining a correct and, so far as is practicable, a constant operating speed has already been stressed. Clean water to help reduce nozzle blockages is essential. These critical requirements are, however, more than offset by the advantages of the technique, the most important being the saving in spray chemical that may be made. The spraying can also be carried out more quickly, with a consequent saving in labour and tractor

operating costs. Growers have reported spraying as much as 50 acres in an 8-hour day, but an average figure is nearer 30 acres. A good day's high-volume spraying, on the other hand, will do not more than 30 acres in 8 hours.

A low-volume spraying concentration of four or five times normal gives satisfactory results, which means that in most orchards there will be a definite saving in spray chemical over the 250 gallon per acre spray rate. Details are given in the following table of the relationship between gallonage and amount of spray chemical per acre for BHC dispersible powder and lime sulphur:

Wash *gallons*	BHC Dispersible powder *lb.*	Lime Sulphur *gallons*
50	8	2½
250	10	6½
300	12	7½
350	14	8½
400	16	10

Note: Normal application rate = 250 gallons per acre.

Spraying Programmes for Fruit All common spray chemicals have been tested in concentrate form and most formulations can be applied by this means. Miscible liquids and emulsions are obviously desirable; they overcome tendencies to nozzle blockage found with dispersible powders and the danger that large quantities of poorly suspended powders may settle out. Winter washes (both DNC and tar oil) are unsatisfactory, and the concentration at which lime sulphur is applied should not exceed 5 per cent (2½ gallons per acre). Lime sulphur, being strongly alkaline, is liable to inactivate DDT, BHC and parathion in concentrate mixes, and the mixture in concentrated form of lime sulphur with certain emulsions can constitute a risk to fruit foliage.

It is possible to make up several low-volume spraying programmes, particularly for apples, using different chemicals and formulations. The programme given in the following table is one example, but it has been widely used and found satisfactory under many conditions:

Pest or Disease	Product	Amount per 50 Gallons of Water per Acre
Caterpillars and aphids	BHC/DDT miscible liquid	6-8 pints
Scab	Lime sulphur or	2½ gallons
	Dispersible sulphur	10 lb.
Sawfly	BHC/DDT miscible liquid	4 pints
Red Spider	CPCBS (50%)	2 lb.
Codling moth	Parathion (20%)	15 fl. oz.

Other products that may be applied at low volume are:

	Amount per 50 Gallons Water per Acre *lb.*
BHC dispersible powder (50%)	8
BHC/DDT combined dispersible powders	8
Arsenate of lead powder	5
Mercurial fungicide	2½ (1¼ in July)
Captan	5

Since the low-volume modification of the Autoblast 2 and 3 to spray at 50 gallons per acre, there have been a number of developments. Growers owning these machines have had no difficulty in modifying them and spray-

ing at least some part of their orchards with 50 gallons per acre. However, these sprayers, with large capacity tanks, large fans and fitted with their own power units, are expensive. Successive increases in the cost of petrol have put up operating costs, leading to the replacement of the petrol by the diesel engine which, while reducing operating costs, has increased the initial capital outlay.

To reduce filling time to a minimum, the tank of a high-volume sprayer should be capable of carrying from 300 to 500 gallons which, at the best, will spray only 2-2½ acres.

Smaller Sprayers and Lower Rates Low-volume spraying means that the same number of acres can be sprayed with a much smaller capacity tank. This has led to the development of smaller, lower-priced machines to meet the demand of growers interested in low-volume spraying but who were unable to invest large sums of money for larger machines. Today, there are several types of smaller machine available with the fan and pump operated from the tractor power take-off. Air-blast attachments to hydraulic sprayers are also available, but, except under ideal conditions, the air-blast is usually too weak to spray big trees. The same argument applies to the sprayer with the fan driven from the power take-off. If, however, they are used for spraying each side of each row of trees, they will do the job adequately.

Man-directed mist-blowers have found favour to a limited extent and they are suitable for small trees provided the operator has sufficient experience in handling the nozzle. The indifferent results sometimes obtained are probably due to lack of experience and possibly to operator fatigue. A tractor driver and a man to direct the nozzle are necessary, which increases the cost of spraying. The advantages of automatic spraying are shown by the fact that some manufacturers of these mist-blowers are now fitting automatically operated nozzles.

Fifty gallons per acre is still the most popular application rate, but there is an increasing interest in even lower rates. As little as 20 gallons per acre have been applied successfully with automatic spraying machines whilst, with mist-blowers, reports have been received of application rates as low as 10 gallons per acre. The low-volume spraying programme given earlier is perfectly satisfactory at application rates of 20 gallons per acre, but the advantages of lower quantities than this are not immediately obvious.

The time and labour saved by reducing application rates diminishes as the rate becomes lower. A reduction from 250 gallons to 50 and even 20 gallons per acre can show quite a large saving, but further reduction will only give a very small return indeed.

Experiments using neat lime sulphur applied at 3 gallons per acre have been carried out. One firm has produced a completely new machine for the application of this product in concentrated form. Yet another now offers a set of nozzles to be fitted to their standard equipment, thus enabling 2-3 gallons of spray per acre to be applied.

Given that there is little saving in the time taken in application, then, without some practical experience of the method, it is difficult to see what precise advantages it has over other methods of which there is now considerable experience. As experience is gained, however, no doubt the special needs of this and other low-volume applications will be elucidated.

The writer gratefully acknowledges the considerable assistance received from his colleague, Mr. F. W. J. Lane of the Fernhurst Research Station, in the preparation of this and last month's article.

WIND SHELTER FOR HORTICULTURAL CROPS

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An account of the principles of small-scale wind shelter and of recent investigations into the virtues of solid, as compared with permeable, barriers.

In recent years there has been a growing interest in the possibility of increasing the yields of horticultural crops by making greater use of shelter, both natural and artificial. Some investigations on small-scale shelter are now being made in this country, but most of the work has so far been done abroad, and Kreutz (1) and Jensen (2) have given comprehensive summaries of many investigations. The primary object of shelter is to modify the micro-climate in a way favourable to plant development, and this is done mainly by reducing the wind speed. The reduction of wind has, however, many secondary effects on temperature, humidity, evaporation, the deposition of dew, and snow drifting, any of which may have an important influence on the plant at certain stages of its development.

In 1954, Gloyne (3) dealt with some of the effects of shelter-belts on local climate and micro-climate, and Fig. 1 is taken from his paper. This illustrates what happens to the air when a solid barrier is placed in the path of the wind. On the windward side there is a region of eddies extending some 2-5h from the barrier (all heights are expressed in terms of h—the height of the barrier). On the leeward side, there is an area of reduced wind speed which extends for some 10-15h. This region is also characterized by eddies; these constitute one of the main disadvantages of solid barriers, for delicate crops such as anemones may be badly damaged by the wind which has passed over the top of the barrier and then moves downwards on the lee side.

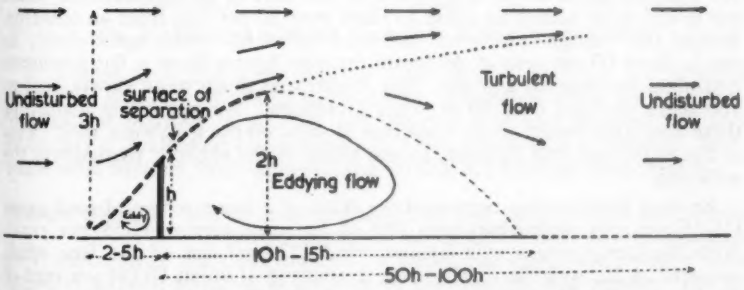

Fig. 1. Flow pattern due to a near-solid, cross-wind barrier

The eddies on both sides of a solid wall can often be seen during windy weather by observing the movement of growing crops; in winter they may be discerned from the motion of snowflakes or the distribution of snow

drifts. If, however, the barrier is made of a "permeable" material, such as wire netting, lath hurdles, hop lewing or reeds, some of the air is able to pass through it. Then there is much less eddying, the airflow is much smoother, and damage to crops is far less likely.

The way in which the horizontal wind speed varies is therefore largely dependent on the permeability of the protecting barrier. In general terms, there is almost a calm immediately in the lee of a solid barrier, but the wind speed soon rises again to its original value. A barrier with a permeability of 40-60 per cent shows a gradual reduction of wind speed on the leeward side, with the minimum usually between 4 and 8h. Subsequently the speed increases much more slowly than behind the solid barrier, and the overall protection is greater than that given by the solid shelter. With a more open screen, such as wire netting, the protection is naturally less. According to Rider (4), some diminution of wind speed may be felt as far as 50h downwind, but for practical purposes no useful shelter is likely beyond, say, 30h.

Kinds of Shelter Compared An idea of the reduction in wind speeds for various types of shelter has been given by Fuss (5) and Nägeli (6). Fuss supported a series of glass lights to form a solid shelter; for a permeable shelter, he stuck poplar branches into the ground to make an artificial hedge. Both shelters were 33 inches high and about 10 yards long, and he measured the wind 8 inches above the ground in a field of winter barley some 4 inches high. His results are summarized in the following table, in which distances are expressed as multiples of shelter height (h) and the wind is given as a percentage of the unobstructed wind speed.

Type of Shelter	Distances from Shelter								
	Windward				Leeward				
	12h	8h	4h	0.2h	0.2h	4h	8h	12h	16h
Glass	91	86	75	55	39	82	85	93	97
"Hedge"	100	87	88	80	75	57	64	82	88

The contrasts between the glass and the "hedge" are striking. Just behind the glass the wind dropped to below 40 per cent of its unobstructed value, but it very soon picked up again to reach over 80 per cent from 4h onwards. Behind the "hedge", however, the wind speed fell much more slowly to reach about 60 per cent at 4h (more detailed figures show a flat minimum extending between 2h and 6h). But it also rose much more slowly, and at 16h there was still over 10 per cent protection. An interesting feature of these and other results is *the reduction of wind on the windward side*. This is due to the fact that air starts to rise ahead of the shelters, particularly the solid one.

Another investigation compared the effect of a dense screen of reed canes (15-25 per cent permeable) with that of an open screen (45-55 per cent). With the dense screen, the lightest wind (23 per cent of the free wind) occurred at 2h; with the open screen, it occurred at about 6h (32 per cent of the free wind). However, on averaging the results from the screen to 30h, the open shelter was found to give some 4 per cent more protection than the dense screen.

As mentioned above, fine-mesh wire netting can provide useful shelter, and Kreutz (1) states that a strip of netting about 3 feet high can give nearly

25 per cent protection, while a rectangle some 6 feet by 18 feet gives about 50 per cent. Such simple screens can be used for protecting small areas of flowers, etc.

Effect of Screen on Crop Performance Investigations are now being made in Britain to discover the effects of various types of artificial screens on the yield, earliness and quality of horticultural crops. Three types of shelter are being tested, each of them 24 feet square and 3 feet high. The first is solid and made of straw bales; the second is made of chestnut laths and has a 50 per cent permeability; the third is very open, being made of a double layer of $\frac{1}{2}$-inch mesh wire netting. The provisional results on crop yields so far support the theory that a permeable shelter screen is more effective than a solid barrier. In fact, a solid barrier often turns out to be a disadvantage and reduces the yield of the crops it is supposed to be protecting!

The effect of a similar 24 feet square lath screen on the wind speed was studied at Rosewarne Experimental Horticultural Station in Cornwall; the measurements were made in the centre of the screen and also outside it at distances of 12 feet (4h) and 36 feet (12h). The results for measurements taken at 1, 2 and 4 feet above the ground are given in Fig. 2. At the 1 foot reading, the average speed was 11.43 m.p.h. at 12h from the screen, and only 5.77 m.p.h. in the centre of the screened area—a protection of about 50 per cent.

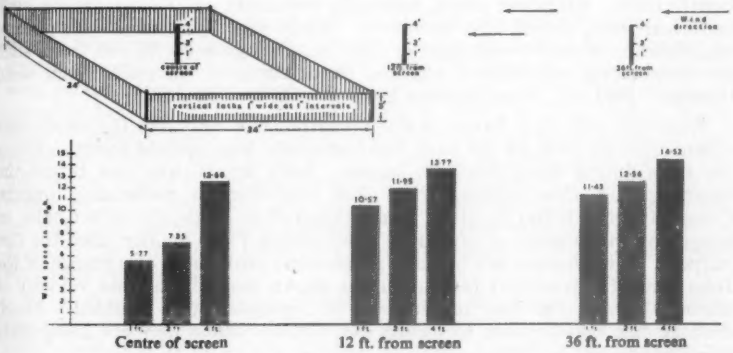

Fig. 2. Effect of a 24 feet square lath screen on wind speed

It is clear from this work that the most efficient materials for artificial shelter in horticulture are to some degree permeable. Not only do they smooth out the flow of air, but they obstruct light and sunshine less and have only a small effect on the amount of rain which falls to leeward. With more solid barriers, both sunshine and rainfall are affected considerably.

Natural Shelters Similar reasoning suggests that many hedges and shrubs will provide good shelter, though it must be conceded that they suffer from the disadvantages of taking up much more space than artificial screens, standing in the way of cultivations, and needing time to establish. Nevertheless, trees, and to a greater extent hedges, are popular forms of windbreak amongst market gardeners, especially in the West Country.

Shelter-belts of trees, which can be seen in many parts of the South-West, reduce the force of the wind for as much as twenty to thirty times the height

of the belt, but the maximum sheltering effect is felt between four and eight times the tree height from the belt. The most efficient type of shelter-belt has a fairly dense shrub layer at its base; the belt should also be moderately dense at the top but reasonably permeable to wind below the crowns ([7]).

For hedges, there is a wealth of material to choose from, ranging from rows of kale to stout thick hedges of *Euonymus* and quickthorn (*Crataegus oxycantha*). Where temporary low protection is required, there is much to be said for rows of tall annual crops such as Jerusalem artichokes, broad beans, sweet corn and staked peas and beans, which are left to give protection during the following winter. Such temporary windbreaks are often seen in the flower fields in the West Country. Three rows of closely planted kale set at intervals of 12 feet provide a very cheap and efficient semi-permeable barrier. In the tobacco-growing districts of the Netherlands rows of staked runner beans protect the soft-leaved tobacco plants from drying winds.

There is, moreover, an abundance of material suitable for providing moderately low, quick-growing hedges which do not rob the soil unduly and are not expensive to buy ([8]).

Crops that need Shelter Most crops benefit by shelter from strong winds. Work in Denmark, Germany and the Netherlands suggests that the yield of some crops may be increased by as much as 35 per cent if suitable shelter is provided. Even crops like potatoes gain by protection from wind. Generally, however, crops grown for decoration benefit most. All flower crops, especially anemones and foliage shrubs such as *Pittosporum*, should have protection. Early vegetables and salads (except cauliflowers, which do not seem to mind wind), together with soft fruits such as strawberries, raspberries, red and black currants, all suffer from wind damage. Red and black currants are particularly susceptible.

Wind can also play havoc in the orchard. Not only can the south-west winds blow the fruit off the trees, but east winds may prevent insects visiting the trees during the pollination season. Such winds, too, can bruise the flower petals, thus making them less attractive to pollinating insects. Generally, it is better to plant plums rather than ordinary shelter-belts or hedges on the outsides of orchards. The Cherry Plum is often used for this purpose. Glasshouses are better if given some protection. Lawrence of the John Innes Horticultural Institution has shown that with a wind velocity of about 20 m.p.h. the heat requirement of a glasshouse is doubled. Much damage can also be done to frames and cloches unless they are adequately shielded.

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UTILIZATION OF THINNINGS

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Greater quantities of thinnings are coming from Britain's forests every year and the supply will soon outstrip present markets. But there are many outlets in industry, as yet untapped, where, with the help of modern machines and techniques, the surplus could be readily and usefully absorbed.

ONE of the most urgent needs in forestry today is the development of satisfactory outlets for thinnings—that is, the trees which must be removed from the woods from time to time so that the remainder may have more light and air. The principal uses for thinnings at present can be broadly classified as : (1) sawn timber, including box boards; (2) mining timber, such as round props, crown trees, chocks, sprags and holing-blocks, and lids; (3) agricultural, horticultural and estate timbers; (4) rustic work; (5) pulp and fibre board; (6) firewood; and (7) Christmas trees and decorative foliage. Mention must also be made of transmission poles for the G.P.O. and electricity authorities, although these requirements can only be met from the later stages of thinnings, when the claims of sawn timber will probably compete. Moreover, such poles are the subject of exacting specifications.

At this point it might be as well to consider the probable future production of thinnings in Britain, as estimated by the Forestry Commission. The figures show that whereas some 15.19 million cu. feet of softwood thinnings were produced in Commission woodlands last year, by 1959 the output will probably be 17.64 million cu. feet. And in 1965 the total volume of thinnings of pines, spruces, Douglas fir and larches in Commission and privately owned woodlands is likely to be 39.13 million cu. feet, made up of 27.77 million cu. feet of 6-inch quarter girth and under, and 11.36 million cu. feet over 6 inches. Ten years later output will have increased to 62.05 million cu. feet, and the yield from Forestry Commission woodlands alone is estimated to be some three times that from all sources in 1955. These figures are rather staggering.

It is obvious from these calculations that the present-day methods of dealing with thinnings will be inadequate, even if these figures tell the whole story—which is by no means certain. It might appear to the inexperienced observer looking at the timber consumption figures for the mining industry that this is an unduly pessimistic view, for in 1950 it was estimated that 100 million cu. feet of timber were required by our mines for props 3-6 feet long and of 3-6 inches top diameter. Provided the National Coal Board's specifications can be met by the home-grown producer (and statistics show that of 85 per cent of Scottish requirements are home produced), the mining industry will always be a profitable outlet. Theoretically, therefore, there is no problem—it is simply a matter of letting the tree attain the necessary dimensions and then supplying the coalfields. Unfortunately, silviculture is not so easy as that, for thinning out and removal of semi-suppressed trees, etc., have to be done regularly through the development of the forest, resulting in a yield of material of infinite variety.

Advantages of the Central Depot A good deal has been written about the utilization, preparation and marketing of thinnings. Generally, the problem has been considered under two heads—on a local basis, when it appertains to a particular estate, or on an area basis.

as in the case of the Forestry Commission depots. There is, in my opinion, much to be said in favour of the area approach to the problem. The advantages are many: all thinnings can be delivered to one site, where the necessary machinery can be installed and the customer can bring his lorries to load. The potential buyer can also inspect the produce easily without awkward travelling to various woods where the thinnings have been piled. The question of economics enters here, and it has to be left to the producer to decide whether he has sufficient output from his woods to warrant the installation of the special machinery necessary for handling this class of material, or whether it would be better to join in a co-operative scheme to feed in his raw material to a central depot. Nearness to potential markets and transport facilities are two of the factors that have to be taken into consideration. It is significant, however, that new factories are being erected close to large areas of production to cope with the increased production.

Most estates have circular saws, driven by either tractors or steam plants, to help them in dealing with the larger trees. A new type of portable band mill has been invented to give quicker and more accurate cutting, but again this does not solve the problem of the smaller stock. But the inventive ability of the English has once again come to the rescue and a new type of circular saw has recently appeared. In general, this consists of twin circular saws on one spindle, one opening from 3 to 11 inches and the other from 1 to 6 inches. It can be adjusted simply according to the type of material being fed through, and can thus produce squared timber easily and quickly. A multiple saw, having up to 12 circular saws of special design, has also been invented to produce laths, fence poles, sawn crate timber, etc., from wood ¼ to 6 inches wide. Special types of cross-cut saws for converting rough timber, both hard and soft, are also available to cut out defects so that clean lengths may be fed to the machines.

It must be mentioned here that to install and use such plant economically it is necessary to have a constant supply and not merely occasional loads. In other words, the central depots or co-operative societies, or specialized timber merchants, would be best able to afford such machinery.

Thinnings in House Construction The strength of timber depends upon many factors, of which rate of growth and moisture content are perhaps the most important. Thinnings generally imply young trees, which, in turn, connotes quick growth. This gives rise to wide annual rings and lack of strength. However, site factors play a part, and some very good class timber, perfectly suitable for a wide range of uses, has been produced from thinnings. Any sawn timber, whether produced from young trees or old, contains a high percentage of moisture, and this must be removed before the material can be used. In other words, the wood must be seasoned by traditional air-drying, which will reduce the moisture content to approximately 16 per cent, or by kilning, which will reduce it to any predetermined level.

To determine whether material obtained from thinnings will be suitable for the construction of houses, bungalows, etc., the Timber Development Association has developed a system of construction involving its use. A prototype building has been erected, as an office for the Forestry Commission, at Santon Downham, Thetford Chase, Norfolk. The system of construction is amenable to modular, or unit, planning: that is to say, standardized and interchangeable units can be used without restricting either the size or design of a particular building. It was deliberately planned to suit very simple woodworking machinery, but mass production methods may be used if desired. To measure the efficiency of the design, tests on the

weathering and insulation values of the various components are being made: their strength is not in doubt.

With the exception of the joinery timbers, which were cut from home-grown Scots pine, and the home-grown oak block floor, all the timber used in the construction of the building was from thinnings of home-grown conifers. The diameter of the logs from which the timber was cut ranged from 4 to 12 inches, and the lengths from 43 inches to 15 feet. The prefabricated wall frames consist of horizontal and vertical members spaced to accommodate standard doors and windows, the panels which are not required for doors and windows having diagonal bracing to provide the necessary stiffening. These frames may be constructed of soft or hard woods.

The skeleton framework itself may be provided in prefabricated units running the full width and depth of a house. Framed together into one large unit 25 feet long and 8 feet high, they would weigh only about 5 cwt., and with a brick party wall three such units would enclose the whole of the plan of a semi-detached house up to first-floor level, giving a stiff, self-supporting structure erected with the minimum of labour. The ends of the first-floor joists would be supported on the tops of the ground-floor frames, the first-floor frames being superimposed and, in turn, carrying the roof structure.

The external cladding units are, in effect, small prefabricated panels made up from 1 inch × 3 inch vertical battens of preserved softwood thinnings, which are fixed to the framework. The sizes may vary to suit the particular dimensions, but it is generally advisable to standardize these measurements in order to simplify production. In this respect, the prototype house has been erected by using 3 foot 4 inch panels.

It is early yet to say whether this type of building will prove to be a commercial proposition, but it has at least shown that sawn material from home-grown thinnings can be utilized in the constructional field. It also opens up possibilities for wider use in the many other timber-consuming industries, such as agriculture and horticulture. In these fields there will always be a demand for poles, fencing, hay-drying tripods, etc., which can well be catered for by private estates. Constructional methods using round timber for sheds and trusses are also being developed.

Other Outlets In this country we are falling behind modern techniques in lamination. Laminated beams, girders, etc., are built up by using small members in conjunction with synthetic resins, and there may well prove to be a good outlet here for small, square-edged timbers cut from thinnings. Much experimental work will have to be done, but this class of material has possibilities.

Insulating boards and hardboards, the production of which is limited in Britain at the present time, are another very important potential outlet for the small class material, which is perhaps the biggest problem to forest owners. These boards have hitherto been made from sawdust and shavings, but new techniques have been developed whereby round thinnings can be hogged down to the correct size. The recent estimates of the potential supply of thinnings will, it is hoped, encourage manufacturers to consider setting up factories for the production of these boards. The new chipboard factory recently opened at Annan in Scotland is a step in the right direction.

The chemical utilization of timber, as a rayon production and paper pulp (where this is produced by chemical, as distinct from mechanical, processes), must not be overlooked, but the raw material required is of such high quality that this demand may well compete with coal-mining; it is very doubtful

whether the supply, even at the future estimated figure, could meet both needs.

The traditional British approach to a problem is, of course, to wait and see. But nature does not wait. The trees continue to grow and continue to need thinning. Although the State, with its large forest blocks, will be hardest hit if there is no expansion in the market, it is in a better position perhaps to supply large quantities to satisfy bulk orders. On the smaller estate or farm, home requirements can probably be met easily, but invariably there will still be a surplus to dispose of, and if there is no chance of pooling resources, then time must be spent in searching for outlets. In this respect it is essential to discover what the consumer requires. In other words, the woodland owner must carry out a form of market research. There is always a demand for timber, provided it is supplied at the right price, in the right condition, and at the right time.

WARBLE FLY CAN BE CONTROLLED

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It is not as widely appreciated as it should be that warbled cattle are a serious economic loss to farmers. Affected animals give less meat and less milk. The corollary is less money.

FARMING is becoming more dependent upon the results of research into agricultural problems in order to achieve maximum efficiency. To this end, research affecting livestock may be considered, on the one hand, as the investigation into the causes and control of disease and, on the other, as the improvement of the quality of the animals and methods of husbandry. Of the disease conditions, there are many that still require intensive investigation before any serious attempt at control can be made, but with others of which sufficient is known to secure their control or eradication, it remains only to apply these control measures when it becomes of economic importance to eliminate unnecessary waste. Warble fly is one example.

It has been estimated that in Britain the warble fly is responsible for damage amounting to many hundreds of thousands of pounds every year. It is not easy to determine the damage done by a parasite which spends about nine months of its life moving through the tissues of the body, and which forms a visible lump in the subcutaneous tissue in the back only at the end of its migration. But we know that the presence of the warble maggots in cattle is sufficient to cause an appreciable deterioration in body condition and, in cows, a drop in the milk yield.

In experiments made by scientists in other countries, when infested cattle were weighed periodically, and one-half of the number were treated with derris, it was found that the treated animals gained ½ lb. more per day than those left untreated. Another experiment, in which two groups of cattle were kept under comparable conditions for two years, and one group was exposed to infestation while the other was protected, resulted in the non-infested group averaging 50 lb. more per beast. It has also been stated that

an animal having thirty warble swellings will lose 3 pints per day of its milk yield. However, there is so much variation between herds and conditions of management that a French worker could find no ill-effects when comparing the weight gains of twelve cattle infested with 430 warbles. That is, there is not always the same degree of loss in every herd, but it may be an important cause of unthriftiness if left untreated.

For many years no agent was known that would kill the warble, until it was discovered that derris applied with soap to act as a detergent was a very efficient and quick method of control. But the sporadic use of this substance in many countries in Europe failed to control the parasite, and it was realized that complete eradication could be achieved only by a concerted effort in every country concerned. The methods required to clear a disease cannot be applied indiscriminately to the varying types of terrain and management existing in different parts of the world. Field trials have to be made to study the problems involved in any particular country. For this reason, the Ministry's Animal Health Division has been trying an experimental eradication scheme in the Isle of Wight, where reinfestation can result only from the importation of beasts carrying the maggots, and which can be controlled.

Isle of Wight Experiment After a preliminary survey in 1953, teams of veterinary officers visited each farm monthly from March to early July the following year, and examined every bovine over the age of six months. It was impossible to assess the degree of infestation while the cattle were loose in fields or yards, so each beast was examined by hand, and nearly all the infested animals were dressed at the time of examination. To ensure penetration of the derris into the ulcer, it was found to be essential to clip the hair over the aperture in long-coated breeds, otherwise the dressing would form a lather in the grease of the coat and fail to reach the skin surface. Results showed that 73 per cent of the total number of herds contained infested cattle during the peak period of April to May, and that of the 20,901 cattle on the island at that time 16 per cent were infested, some of them with large numbers of warbles.

The work was repeated in 1955, when a great improvement was observed, and at the same time it was unanimously agreed that the cattle were quieter and in better condition. This was helped by the exceptionally fine summer. In the peak period of 1955, only 32 per cent of the herds contained affected cattle, and only 4.5 per cent of 21,977 cattle examined were infested. Moreover, there were far fewer warbles to be found on infested animals than in the previous year, and in many cases only one or two animals, carrying at the most three warbles, were found in a herd.

As derris properly applied is extremely efficient, a careful investigation was made to find out why some cattle were warbled in the second year. One reason was the importation of infested animals at a time when the maggots were still moving through the body, and these added to the number of cases discovered the following season. In other instances, the hair was not clipped close enough on beasts with long coat hair, and occasionally a warble would be protected by a secondary seal of pus in the ulcer.

As each fertilized female fly may potentially give rise to 400 new warbles, it is essential that *every* warble should be killed to ensure eradication.

It is unfortunate that the season for dressing (mid-March to the end of June) conflicts with haymaking and preparations for harvest, for at this time the young steers and heifers that are most susceptible to attack are often on outlying pastures and have to be brought in, sometimes for nothing when no warbles are found. But as treated animals thrive better than those left

untreated, and as the warble fly does not travel far, nor leave one bunch of cattle to search for others, any farm that gets rid of all the warbles will remain clean, except perhaps for a few beasts in outlying fields adjacent to cattle bearing a heavy infestation.

Success in any endeavour is seldom attained easily, but in this matter of controlling warble fly, the means to succeed are there for the taking with so little effort.

The Warble Fly (Dressing of Cattle) Order of 1948 requires owners and persons in charge of visibly infested cattle to dress those animals with a derris dressing at monthly intervals between March 15 and June 30.

THE MINISTRY'S PUBLICATIONS

Since the list printed in the December 1955 issue of AGRICULTURE (p. 432), the undermentioned publications have been issued.

MAJOR PUBLICATIONS *Copies are obtainable at the prices quoted from Government Bookshops or through any bookseller.*

Bulletins

No. 55 Outdoor Salad Crops (*Revised Oct. 1955*) 2s. 6d. (2s. 7½d. by post)
No. 143 Salad and Other Food Crops in Glasshouses (*Revised September 1955*) 2s. 6d. (2s. 8½d. by post)
No. 146 Poultry Breeding (*Revised October 1955*) 4s. 6d. (4s. 11½d. by post)
No. 165 Weather and the Land (*New November 1955*) 3s. (3s. 1½d. by post)
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Poultry Stock Improvement Plan (*New December 1955*)

DR. H. E. WOODMAN

HERBERT ERNEST WOODMAN, M.A., Ph.D., D.Sc., died in Cambridge on February 13, 1956, at the age of 66. So passed one of the foremost authorities on animal nutrition in this country; a man, known personally to few outside his colleagues and the successive generations of University agricultural students, who by his researches and writings has probably exerted more influence upon livestock feeding practices in this country than anyone else over the past three decades.

Born in 1890, he graduated in honours organic chemistry at Leeds, and on the award of an 1851 senior exhibition continued his studies in Göttingen for the Ph.D. degree just before the First World War. He returned to Leeds under Crowther at the Animal Nutrition Institute, and when the Institute was transferred to Cambridge at the cessation of hostilities he joined T. B. Wood at the School of Agriculture and spent the next thirty-five years in Cambridge. His work at Leeds had gained him the D.Sc. degree. In addition to his research work, he became progressively Demonstrator, Lecturer, and Reader in Agricultural Chemistry, and he also directed the agricultural studies of students of Downing College. His published research work amounts to over a hundred papers, mostly in the *Journal of Agricultural Science*, and older readers will remember his valuable series of "Notes on Feeding", in this JOURNAL.

Dr. Woodman wrote several bulletins for the Ministry, but his *magnum opus* was surely Bulletin No. 48, *Rations for Livestock*, now in its 13th edition. He assumed responsibility for this bulletin on the death of T. B. Wood, and each new edition brought with it the latest accretions of new knowledge and progress in livestock feeding. It is impossible to assess the vast influence of this bulletin on current feeding practices; its wide circulation and ever-increasing popularity are alone evidence of the thought and care which were devoted to its preparation.

His research work ranged over a very wide field. His early studies were devoted largely to the nature of ensilage processes, and these were followed by his near-classical work on the nutritive characteristics of pasture grass, which paved the way for improved grassland management, and the grass-drying industry. Incidental work on sugar beet by-products, kale, lucerne and feeding standards for sheep was followed by his long series of studies on the nutrition of the bacon pig. During World War II his advice played a very useful part in the administration of official farm stock rationing policy. Every piece of work was carefully planned, ably executed, and written up in a logical, clear and convincing manner; indeed, his papers are models of perfection in the art of writing.

As he wrote, so he lectured. Every sentence was carefully thought out, beautifully delivered, simple and to the point. He always commanded attention, interest and respect. He rarely lectured outside the classroom. His life was devoted to his research and his University lectures, and though he gradually relinquished his researches, he continued his lectures to the last. Mercifully his illness was brief, and his end was peaceful.

Dr. Woodman was a man of exceptional gifts, but with them he showed a remarkable depth of human understanding, sympathy and charitableness. To those of us who knew him intimately, he was always willing to help, to guide, to advise and even to console. Ever ready to praise, most reluctant to blame, he commanded the affection and admiration of all who knew him, and at all times and in every way he was a perfect gentleman. As Johnson said of Goldsmith, . . . *nullum quod tetigit non ornavit*—he touched nothing that he did not advance.

A. Eden

FARMING AFFAIRS

Farm Storage of Tractor Fuel More and more farmers nowadays are keeping their vaporizing oil and diesel oil in bulk storage tanks. What are the advantages of this system? In the first place, you don't have to bother with the time-wasting business of handling drums and cans; secondly, the price per gallon is less if you buy a lot at a time; thirdly, there is less risk of fire, of dirt or rainwater getting in the fuel, or of running short of fuel just when it is badly needed; and, lastly, good storage can reduce the wastage likely to occur when filling up from drums. An added attraction is that some of the fuel companies are selling tanks specially designed for the job, though you should examine all the different types offered to make sure which is the best for your needs. There is, however, usually no advantage in storing petrol in bulk; the tank has to be underground and it is costly to install.

How much are you likely to save by taking a bulk delivery of vaporizing oil or diesel oil? On a delivery of 500 gallons of fuel, you can save, on present prices, over £12 on diesel oil and over £14 on vaporizing oil, compared with the cost of buying it in 40-gallon drums. These savings will go some way towards paying for the tank. The prices of tanks offered by the different companies vary; but hire purchase terms are often available, and there is also income tax relief on the cost of buying and installing a tank.

When choosing a tank remember that diesel oil attacks zinc. Thus a galvanized tank is not suitable. A tank for diesel oil should be of "black iron" (descaled, black, untreated mild steel) and mounted so that it is tipped slightly out of the horizontal. The sludge will then settle at one end, the oil being drawn off from the other. Both vaporizing and diesel oil tanks should be mounted high enough above the ground to enable tractors to be filled from them by gravity.

The tank should be large enough to hold a month's supply for the tractors on the farm at the busy season, plus a reserve in case there is a delay in replenishing the tank. In this connection, it is wise to consult the supplying company to find out how frequently they can deliver to the farm.

It is important to choose a site for the tank where it will be easily accessible to both the road tanker replenishing supplies and to the tractors which it will serve. That means it should adjoin a hard road, with a turning place close by. If the road is narrow and well used, the tank should be set back two or three yards to enable tractors to be refuelled without causing an obstruction. Setting back the tank from the road may also keep it out of the way of passing loads of hay and straw.

Another very important point is that the fuel storage tank should be sited where it is not likely to catch fire and away from buildings or stacks. If possible, it should stand on its own and where the prevailing wind will not spread fire to or from it.

N. K. Green

Farm and Forest: 12. Planting Methods As explained in last month's note, the choice of planting method will depend on the nature of the soil and its texture, as well as on the species concerned. Pit planting, which involves digging a hole wide and deep enough to take the roots of the tree in their natural shape, is the most expensive method and is seldom economic in commercial silviculture. It is usually

adopted for large transplants. In heavy land it is often convenient to dig the holes in advance, so that the soil may weather, although this is not practicable in wet areas, since the holes would soon become full of water. An ordinary garden spade can be used for the job, in the same way that one plants a small shrub in a garden.

A quicker and cheaper way of making pits is with a mattock. This may be used successfully with small plants on steep hillsides and on ground which cannot reasonably be planted in any other way. Great care must be taken to see that the hole is made deep enough and that the roots of the plants are not cramped.

A more common planting method is known as notch planting. The difference between pit and notch planting is that in the former the soil is lifted right out, leaving an open hole, while in the latter a space is held open just long enough for the roots of the plant to be inserted. A cut is made first along the line where it is intended that the roots should go. A second cut is then made at right angles to the first and the soil prised up with the spade so as to make a cleft. Into this cleft a plant is placed with the tops of the roots just below the prised-up soil. It is wise to put the plant in rather too deeply and then pull it up slightly to make certain that the roots are straight. The spade is then removed and the soil falls back, taking the plant with it. Finally, the soil is consolidated with a firm pressure of the heel. The simplest form is the "L" notch, which can be made with an ordinary garden spade, but there are several variations, such as the "T" and the "H" notches. Nevertheless, the principle is the same.

If seedlings should have to be used, an ordinary dibble, or a vertical notching spade known as a Schlich, can be used to make a narrow cleft just sufficient to take the roots. Another form of notching spade, known as the Mansfield, is an excellent tool for planting oak seedlings. Whichever spade is used, the notch or slit must be closed by reinserting the tool alongside the original cleft and forcing the soil together again. Care must be taken to see that the plant is not "hung"—that is, that the top of the slit is closed while the bottom remains open.

Turf planting is used for the formation of spruce and similar plantations on peaty or sour soils. The method is to cut turves at least 15 inches square and from 4 to 6 inches thick (these can be taken from drains which may have been opened to allow the free run-off of water). A cut is made with a sharp spade from the middle of the turf to the side farthest from the direction of the prevailing wind, and the edge is lifted high enough to open the slit and permit the roots to be inserted under it. The stem is then brought right into the centre of the turf, leaving the roots spread out flat between the turf and the natural surface vegetation.

Ploughing has also made it economic to plant on some large, peaty areas. The "L" notch procedure is adopted, cuts being made on the top of the out-turned furrow, with the plant roots lying between the surface vegetation. Only in very dry and exposed conditions should the plant be inserted in the furrow bottom.

S. J. C. West,
District Officer, Forestry Commission

At the Farmers' Club: SOVIET AGRICULTURE

Sir Peter Greenwell, who went to Russia last September as a member of the official delegation under the leadership of Mr. R. Nugent, Parliamentary Secretary to the Ministry of Agriculture, gave his impressions on Russian farming on January 4. Farm collectivisation started about 1930 and was warmly welcomed by the peasants, who still form about half the total popu-

lation, as an opportunity to possess their land, but, said Sir Peter, "a peasant agriculture is not suited to providing food for a large and rising industrial population". His party visited Collectives ranging from 3,500 to 67,000 acres. The smallest one had a large area of glass, and the largest was in the virgin soil area and in transition from grazing to corn growing.

A vast plan to plough up 75 million acres of virgin soil has been set in motion and will be achieved in little more than two years. This will greatly increase wheat production and replace the grain grown on that part of the old lands which had been switched to maize. One must give the Russians great credit for the way in which they have tackled this gigantic undertaking. Admittedly they are only at the beginning of the venture, but the magnitude of the task is apparent when, as the party did, one flies for hours on end over tracts of steppe land which appear to be hundreds of miles from any habitation.

The Permanent Agricultural Exhibition, just outside Moscow, must also be considered as a big effort to create enthusiasm in the task of increasing agricultural production. It is a most lavish spectacle and the theme throughout is always achievement, by republics and by farms, of increased production.

Sir Peter drew attention to some of the special difficulties facing Russian agriculture. The greatest perhaps is that of the leaders in trying to change the outlook of a backward peasant population and creating enthusiasm and determination to make a success of their collective farms. It should be borne in mind, too, that most of Russia's best farm land was devastated by war and fought over at least twice.

Russia is fully mechanized as regards the main and heavier farming operations. The machinery, which is not unlike American products to look at, is well made and massively so in many cases. About half the tractors which Sir Peter saw were crawlers. One machine was particularly impressive: it was a silage combine capable of cutting, chopping and loading 2½ tons of sorghum in 12 minutes.

Speaking of cattle, Sir Peter said that there appeared to be many breeds, and although there were herds of Friesians with 1,000 gallon yields, the country's average is said to be 300 gallons. While their cattle can survive the long winter on a low nutritional scale, one wonders whether they are genetically capable of high yields. The practice of milking low yielding cows three times a day is difficult to understand.

This was a most interesting paper, which can be read in full in the Club's Journal, free to members. All farmers at home and overseas are eligible for membership of the Farmers' Club. The subscription is three guineas a year for country members or one guinea for overseas members. The Secretary of the Club, 3 Whitehall Court, London, S.W.1, will be pleased to give full particulars of what the Club offers.

Farm Adoption Scheme extended to Canada It is most encouraging to watch the continued success attending the Association of Agriculture's Farm Adoption Scheme. A simple idea—to bring Britain's farms into the school room by providing detailed descriptions, maps, progress, reports, etc.—it rapidly caught the imagination of teachers and pupils alike when it was introduced five years ago.

Last year, as the result of a grant from the Nuffield Foundation, a new series, entitled "Farming in the Commonwealth", was begun, and two New Zealand farms were added to the eight in England and Wales. The latest step forward is the addition of four Canadian farms.

Because of the vastness of the country, it is, of course, impossible to give anything like a comprehensive picture of Canada's agriculture by such a small sample. But the four provinces concerned—Nova Scotia, Quebec, Ontario and Manitoba—are distinctly different in outlook, history, farming practice and land formation, so the farms selected can justifiably be claimed as representative. They are, in fact, quite distinctive in themselves, comprising a 270-acre mixed farm in the Annapolis Valley, a 220-acre dairy farm south-west of Montreal, a 315-acre mixed holding on the fertile belt between the Great Lakes, and a 1,200-acre grain farm on the Portage Plains.

The great virtue of this expansion is, however, the opportunity which it affords for boys and girls to raise their horizon beyond the confines of their own shores to the rich and varied farmlands of the Commonwealth. The fulfilment of the next aim of the Association—to include Australian farms—will be eagerly awaited.

Details of the Scheme are obtainable from the Association of Agriculture, 53 Victoria Street, London, S.W.1.

Journal of Agricultural Engineering Research We extend a warm welcome to this new and extremely well-produced journal which comes from the British Society for Research in Agricultural Engineering, Wrest Park, Silsoe, Bedfordshire. The Editor-in-Chief is W. H. Cashmore, C.B.E., and the Technical Editor M. A. W. Taylor. "The lack of a suitable journal for agricultural engineering research," says Sir William Slater in the foreword, "has been very evident for some time, but it has been doubted whether there was enough material of the necessary quality to justify a new journal. After a careful re-examination of the position by a group of those responsible for this type of research, it has been decided that enough material is now coming forward to warrant such a journal."

Articles in the first issue are concerned, among other subjects, with potato damage, the effect of rotary cultivation on rhizomatous weeds, comparative traction aids, bacterial growth on drip feed irrigation lines, the measurement of soil moisture levels, and the performance of soil cultivation implements. Summaries of the principal articles are given in English, French and German, which will be of considerable help to overseas readers and libraries. The text is clear and the illustrations, both half-tone and line, of a very high standard indeed.

The subscription in the British Isles for two issues is one guinea a year (students 12*s.* 6*d.*); single copies 10*s.* 6*d.*: abroad (for two issues), one guinea, plus 1*s.* postage by sea mail.

New Weed Control Guide So rapid have been the advances made during the last ten years in the field of chemical weed control that few, apart from the specialists, can claim to be fully conversant with the potentialities of all the types of herbicides commercially available. A warm welcome is therefore assured for the British Weed Control Council's *Weed Control Handbook, 1956*, which classifies all weed-killers in common use in Great Britain and sets out the agricultural and horticultural crops on which they can safely be used, as well as indicating clearly the weeds which can be controlled by each chemical. There are also sections dealing with problems of applying herbicides, such as spraying procedure, how to minimize the risk of spray drift, and decontamination of the spraying equipment.

Copies of the Handbook are obtainable from the British Weed Control Council, Cecil Chambers, 86 Strand, London, W.C.2, price 5*s.*

IN BRIEF

Grain Storage and Moisture Content

From experiments that have been carried out at the National Institute of Agricultural Engineering, it appears that wheat cannot be stored for long periods at 14 per cent moisture, unless it is harvested below 19 per cent moisture. For shorter periods, this figure can be raised to 22 per cent, provided storage is in sacks and not in unventilated containers. The same harvest level of 22 per cent moisture will allow dried barley to be stored even in containers without a drop in germination, and for initial germination and storage life 19 to 22 per cent moisture is the most satisfactory range at which to harvest oats.

Whatever the moisture content, all grain should be harvested with medium clearance to the concave and with the slowest possible cylinder speed. The higher the moisture content, the more important this becomes. In general, the concave clearance should govern the degree of threshing and the cylinder speed that of damage. If too many heads of corn are coming over unthreshed, then a closer concave setting should be used and a slower cylinder speed if the individual grains are being damaged.

No grain if at all damaged should be stored without drying, and even if it appears undamaged, then only at a maximum moisture of 18 per cent and in sacks spaced so that the air can move freely around them.

The order of these crops in their susceptibility to deterioration in store and damage at harvest is apparently wheat, oats and barley, and in practice they should be dried in that order should an occasion for priority arise.

From a paper by F. S. Mitchell, read to the Institution of British Agricultural Engineers, January 24

S S S

Record Bull Price

£16,800 was paid for the eleven-months-old Aberdeen-Angus bull "Black Baron", Supreme Champion of the Aberdeen-Angus Cattle Show, at Perth last month. This price not only beat the previous record for the breed (11,500 guineas) but also the British record price of £16,000 paid for a pedigree Hereford bull in 1953. "Black Baron" was shown by Messrs. Osmond of Barnoldby-le-Beck, Grimsby, and was bought for Mr. L. L. O'Brien of Wisconsin, after just over a minute's bidding.

S S S

Economic Surplus is not Nutritional Surplus

Dr. A. H. Boerma, Director of F.A.O.'s Economics Division, told the recent F.A.O. Conference that the world food surplus situation is not because of the lack of human need, but because of a lack of purchasing power among most of the world's population.

Dr. Boerma said the level of purchasing power is likely to be the effective ceiling for both agricultural production and consumption for some years to come. He asked governments to give the same attention to expanding consumption—through consumer education in nutrition, and through measures to reduce the costs of production and distribution—that they have in the past and must still in the future give to expanding production.

The F.A.O. Economics chief also urged greater co-ordination of national policies on production and marketing. He said this should be done so that farmers could be in a better position to suit their national production patterns to the realities of world markets.

Dwarf Bunt of Wheat

Bunt of wheat, caused by the fungus *Tilletia caries*, is less of a problem to farmers today than it used to be, because of the general practice of seed dressing. But another disease, Dwarf Bunt, caused by a related, though quite different, species of *Tilletia* has been causing concern on winter wheat in parts of America and Canada and, more recently, in Europe—Germany, Austria, Italy and Switzerland. Fortunately it has not so far been found in Britain.

In both these diseases, grain from infected ears contains nothing but black masses of fungus spores, but Dwarf Bunt, unlike Bunt, cannot be controlled by seed treatment. It has come into prominence abroad only in the last fifteen years or so, but it has probably been present, though unidentified, for a very much longer time. It differs from Bunt in that infected plants show excessive tillering and are only half to one-third as tall as healthy ones, but usually resembles it in bearing "open" ears. Dwarf Bunt has been found on rye and it also attacks a range of grasses: in fact, it is said to be a serious threat to seed production of several forage grasses in parts of America.

Bunt spores that reach the soil die fairly soon, but those of Dwarf Bunt remain alive for at least two years—probably longer—and can infect seedlings during that period. This relatively new disease is therefore carried in the soil as well as on the seed, and the normal routine seed dressing does not protect germinating grain from soil infection. Nevertheless, treatment of seed is being advised abroad to help reduce the chances of the disease spreading from infected crops. Among the more promising methods of control, pentachloronitrobenzene products have proved useful in reducing infection considerably when applied as dusts to contaminated soil. In parts of America, crop losses have also been reduced by growing resistant wheat varieties.

Plant Resistance to Insects

The resistance of particular plant varieties appears often to depend upon some subtle physiological change which leads to the insect growing or reproducing more slowly. The Colorado potato beetle which thrives so well on the ordinary potato *Solanum tuberosum*, appears to feed quite happily on the closely related *Solanum demissum*, but it grows more slowly and is hardly able to reproduce. The same thing can be seen in a single plant under different physiological conditions. As Kennedy and Booth have shown, young shoots or wilting leaves of beans are much the more favourable for aphids—because they are the richest in nitrogenous compounds in process of mobilization.

Could we aim at inducing such chemical changes in the plant by chemical means—so that by applying some harmless chemical to the plant its metabolism may be so affected that while it will remain unchanged so far as man's requirements go, it may become ill-suited as a host for the insect pest? That would indeed be a beneficent sphere of activity in which the chemist might still further display his talents.

Dr. V. P. Wigglesworth at the Royal Society of Arts

Cornish Broccoli

Growers have asked the Ministry to investigate the production and marketing of Cornish broccoli this year. This is being done in collaboration with the University of Bristol, and the survey will cover both the methods of growing and the quality of the produce on the farm and in the market. The results should be available in the autumn.

Heather Grazing is Healthy Grazing

Most hill shepherds like a "bit o' heather" for their flocks; and not without good reason, since a diet containing heather has been shown to give protection against troubles arising from certain mineral deficiencies. With the exceptions of phosphorus and potassium, heather is a remarkably mineral-efficient food. Mr. Brynmor Thomas, of King's College, Newcastle, writing in the autumn issue of *Scottish Agriculture*, says: "The edible portion, leaf and stem, contains as much calcium and magnesium as the general run of pasture grass at the grazing stage, and actually contains more of the trace elements iron, manganese, copper and cobalt. This fact, linked to the knowledge that pine, a disease caused by cobalt deficiency, is very uncommon on hill land with a reasonable proportion of well-managed heather, suggests that heather may prevent certain deficiency diseases. The high lime content of heather is surprising in a plant almost invariably found on highly acid soils, but this is a characteristic of all the typical black land plants. Another interesting, unexpected and, possibly important, feature is the negligible decline in the mineral content of heather up to at least ten years after burning; month-to-month variation is very similar to that found in pasture species, there being a steady fall in most of the ash constituents as the season advances."

Heather is not a particularly rich source of digestible protein or of starch equivalent, but in winter, under ice- and snow-bound conditions, it may be the only food on the ground accessible to sheep, and it will keep life in them for some weeks at least. The hill farmer who has a good stretch of heather may, in a bad winter, be saved considerable expenditure on hay.

Nitrogen on Grass

Like David and Jonathan, grass and nitrogen are inseparable associations. Few crops give a more spectacular increase to nitrogen than does grass. In ordinary farm practice, 1-2 cwt. per acre "Nitro-Chalk" is the usual early spring dressing, and a similar quantity can often be given usefully after a hay crop to boost the aftermath grazing.

Fields laid up for hay or silage will commonly benefit from 2 cwt. per acre sulphate of ammonia in March. And if you are cutting for grass drying, remember that the drain on soil nutrients is heavy. The principle here is to put in a good basis of phosphate, potash and, where necessary, lime, and to dress with quick-acting nitrogen for each cut.

Big Apple

A rare variation of the Winesap apple tree—a tetraploid plant with double the normal number of chromosomes, tending to produce extra-large apples—has been developed by the U.S. Department of Agriculture plant breeders at Beltsville. This unusual tree, the scientists hope, will provide new breeding stock that may help growers produce large-size apples having the high quality and disease resistance of the Winesap. The new tetraploid apple originated as a bud sport—that is, a branch with different chromosome make-up—found on an otherwise normal Winesap tree.

Eggs without Shells

Scientists at Cornell University, U.S.A., are experimenting selling eggs without shells. The eggs are contained in twelve-compartment plastic packets, and it is claimed that they are cheaper and just as good as eggs in shell.

BOOK REVIEWS

Capital in United Kingdom Agriculture Present and Future. STEPHEN CHEVELEY and OWEN PRICE. Netherhall Press, London. 2*s.* 6*d.*

Everyone who is interested in the economic condition of British agriculture should read this publication. It has been well produced and has something positive to say. The main argument is based on the premise that greater productivity in agriculture, with lower unit costs of production, can be achieved through increased output; and that to achieve this higher output it would be necessary to invest a substantial amount of capital in farming. In order to develop the case for this new investment, a bold attempt is made to measure landlords' and tenants' capital, now and pre-war, and the respective returns on these investments. The authors have concluded that the landlords' capital is a deteriorating investment, while the returns on tenants' capital vary from a reasonable level on larger farms to inadequacy on smaller farms. They go on to suggest that under these circumstances the only real saving potential could be developed from high incomes resulting from increased output.

It is claimed that, in order to gear the existing organization of farming for a higher level of output, an investment of about £400 million would be required for farm buildings and piped water supplies, and £60 million for farm electrification. On this basis, a budget is developed to double the output of lamb and mutton and to add 300,000 tons to beef supplies over a five-year period. An increase in the output of grassland of the order of 33 per cent would be looked for (with a substantial offsetting effect from a decline in purchased feedingstuffs). As a result of these improvements, the net income of the farming industry would increase by £60 million. At the same time, import requirements of both meat and feed would show a substantial decline.

The capital necessary for the expansion, it is claimed, should be provided to farmers at a sub-market rate of interest by either a state credit institution or through normal credit channels with state support. The state, it is suggested, should also form "a central farm loan organization . . . to encourage and promote sound farm investment schemes". The authors conclude by admitting the necessity for large-scale advisory and educational work to give farmers an appreciation of the value of credit as a productive agent. And for this purpose they envisage the need for training more technical advisers to stimulate the demand for credit for farming expansion and to guide the latter along the best channels.

In such a comprehensive scheme as this, it is inevitable that disagreement could be taken to various stages in the argument and to various aspects of the proposals. But, the authors make no absolute claims for their proposals and they conclude modestly: "We have presented facts and ventured to draw conclusions, and if in so doing we rouse interest and controversy we shall not have worked in vain." On these grounds, the booklet should be regarded as a basis for discussion and not as a blueprint for action.

J.A.

Report on Forest Research for the Year ending March 1954. H.M. Stationery Office. 6*s.* (6*s.* 3*d.* by post).

Added interest is given to the latest research report of the Forestry Commission by the inclusion of a new "experimental" section. This comprises a series of papers on individual investigations being carried out by members of the research staff, in which it is considered that sufficient information has been obtained to justify publicity, even though the results may be only provisional. The decision to include this material will doubtless be widely applauded; although firm recommendations may not be possible, it is encouraging to the woodland owner to learn that investigations are proceeding into certain problems.

Another new feature is a list of the more important areas where experiments are being done.

The rest of the report is made up of brief summaries of the main items of work of the Research Branch of the Commission and of the projects being undertaken by the universities and other institutions. The scope of this research is indeed extensive, ranging from the testing of seed and nursery work to machinery development. A good deal of useful work is also being done on soils, diseases and forest pests, but probably of greatest interest to the farmer will be the report of progress in timber utilization and marketing, and a brief reference to experiments planned at Edinburgh University to test the effect of shelter belts on the micro-climate.

L.W.T.

BOOK REVIEWS

So Bold an Aim: Ten Years of International Co-operation toward Freedom from Want. P. LAMARTINE YATES. F.A.O., Rome, H.M. Stationery Office, London. 7*s.* 6*d.* (8*s.* by post).

Last October, the Food and Agriculture Organization of the United Nations celebrated its tenth anniversary. Mr. Yates's book, *So Bold an Aim*, written to mark the occasion, describes the ideas and events which led up to the formation of F.A.O., and those which have since moulded its activities into their present shape. Mr. Yates writes with the authority of one who was on the staff of F.A.O. during its formative years. At the same time his wider experience, both before and since, has enabled him to assess the full impact of the ideals and achievements of F.A.O. on the underdeveloped countries of the world.

In the opening chapters the author shows how vulnerable is agriculture in the face of industrial expansion. With its small, widely scattered units, it is inevitably weak both economically and technically, compared with urban industry. For this reason, agriculture has, of necessity, had to become dependent on the activities of Governments. The fact that Europe was able to survive extensive industrialization two hundred years ago and still raise its nutritional standards is, the author claims, sufficient encouragement to believe that the under-developed countries of the world can make similar advances today.

Rome, Mr. Yates recalls, was also the home of the forerunner to F.A.O.—the International Institute of Agriculture, which was set up in 1905. The experience of this organization was to prove invaluable forty years later when the architects of F.A.O. decided that something had to be done to remedy the problem of food shortages and poverty in the midst of plenty.

The book goes on to describe how the problem of world food shortage in the immediate post-war years was quickly followed by the problem of surpluses in some areas, and how F.A.O. overcame these conflicting situations. Finally, the author outlines the likely role of the organization in the future.

This is a thought-provoking book, worthy of the attention of not only those who willingly accept the obligation to support and assist the work of F.A.O., but also of the vociferous minority in this country who sometimes question the wisdom of the United Kingdom's support of the organization. On ethical grounds alone, it provides an unanswerable case for our continued participation.

A.D.B.

Machines of Plenty. STEWART H. HOLBROOK. Macmillan. 28*s.*

"Could a farmer of the Pharaohs' time have been suddenly set down in our grandfathers' wheat fields," said a United States Secretary of Agriculture in the late 1920s, "he could have picked up the grain cradle and gone to work with a familiar tool at a familiar job". The revolution in the use of farm machinery in the last hundred years, after five thousand years of stagnation, is the theme of this book. As presented by Mr. Holbrook, it is an engrossing story, given cohesion and life by being built around the career of Jerome Instant Case.

The book deals mainly with the manufacture of machines but is enlivened by stories of selling (and in particular of obtaining payment), of advertising and of "bally-hoo". Why should Case label "Important" an advertisement which read: "Pure water without any admixture of whisky is all that is needed to make steam . . ."? Who cannot visualize the wheat fields of the bonanza farmers stretching unbroken from Minnesota to the Pacific, except for "about 200 miles" where they changed to buckwheat, because of the stone, as they crossed the Rockies?

Naturally, speculators and swindlers had their day in the expansion, but the firms that survived are those whose principles still characterize the American engineering industry—the best of materials and workmanship, fair dealing and impeccable service. The tone is set by J. I. Case who, late in life, went personally to adjust a threshing machine that had defied all the efforts of his local staff, and, overcome with shame at his own failure to make it work, called for kerosene and set fire to it. Says Mr. Holbrook, "One may hope that the incandescence of Hell itself could have been no more luminous nor that a sinner in the Pit was ever consumed more surely than this machine which had sinned so dreadfully against its maker".

This is a fascinating book, of value to both engineer and historian and of interest to all for its insight into the American scene. The illustrations are admirable and the bibliography excellent.

N.F.McC.

BOOK REVIEWS

Long Ashton Research Station Annual Report, 1954. 15*s.*

Progress is reported on many aspects of fruit research, including varieties, nutrition, cider problems, fruit sprays and spraying technique, and fruit preserving. An account is given of rootstocks suitable for new plum varieties raised at the Station, and there is also a very well-illustrated description of perry pear varieties grown in south Herefordshire.

Interesting experimental results recorded in the Report include those on the fungicidal activity of different tar oils, the technique of gooseberry propagation, and on injury to apple trees caused by a fruit-ripening spray. In the section dealing with fruit spraying it is reported that virtually complete control of the winter eggs of the Red Spider mite on apple trees was obtained with chlorbenside spraying at the pink-bud stage. It is also noted that the inclusion of an acaracide in a DDT-BHC emulsion promises to establish spring spraying as a complete substitute for winter washes.

Comparison of large-volume and small-volume (air-flow-mist blower) spraying for scab control on apples showed that six air-flow applications of lime sulphur (2 per cent) at 50-100 gallons per acre gave almost the same level of control as five hydraulic (lance) sprays using 1 per cent lime sulphur at 400 gallons. In contrast, large-volume sprays brought about extensive russeting on Cox, ruining about half the crop. Captan used for scab control on Cox was found to eliminate the sulphur injury which arises in this variety with lime sulphur sprays, and it also reduced russeting and improved the size of fruit, although the incidence of Apple Mildew was higher than with lime sulphur. Small-volume sprays also appear to be promising for Potato Blight control, judging from experiments carried out at Long Ashton.

In the section on domestic food preservation there are two interesting reports on the effect of bottling, canning and freezing methods on the colour and flavour of strawberries, raspberries, peas and beans.

A.J.L.L.

Practical Poultry Keeping (5th Edition). Poultry World. 10*s.* 6*d.*

Revolutionary developments have taken place in almost all branches of poultry farming since the end of the war. Instead of dabbling in several different forms of production, most poultry-keepers now specialize. This has resulted in new methods of approach, new types of equipment, and perforce new problems and ways of coping with them.

With a view to bringing the information which it contains into line with these developments, *Practical Poultry Keeping* has been completely rewritten by the *Poultry World* advisory staff, in collaboration with other specialists. The result is a manual of simple and practical advice which will answer many of the questions so often asked by the beginner. In addition, the book contains much useful and interesting information for the more experienced. Of course, much of the material cannot be entirely fresh and new, but there is a good deal that can bear repetition and act as a reminder, lest we forget some of the essentials in day-to-day routine. For example, now that home-grown cereals are cheaper, it is rightly stressed that they must be supplemented with the right kinds of protein and vitamins, and not just fed in conjunction with an ordinary balanced layers' mash.

The scope of the book may justifiably be described as comprehensive. Particularly interesting is a concise and not over-technical account of the common poultry diseases, together with notes on methods of prevention and control. The chapter on turkeys, in addition to discussing feeding and management, gives useful information on food consumption at different ages and food conversion rates. One result of a number of experts having contributed different sections is that there is a certain amount of repetition on subjects such as hatchability, antibiotics, broiler production and deep litter. This, however, is virtually inevitable, and, generally, the information is up to date and given in a clear, balanced manner. The reader is also left free to decide which course of action to pursue.

Practical Poultry Keeping is well illustrated with photographs and line drawings, and should serve as a most useful publication, both as an introduction to poultry-keeping and in providing for the more experienced a logical explanation of why certain accepted methods should be adopted. It is regrettable, however, that the new edition carries no date of publication. This is a serious omission, for with advancing knowledge and changing ideas it is essential to know, when buying a text-book, just *when* it was actually published.

J.W.S.

BOOK REVIEWS

The Rhododendron and Camellia Year Book, 1955. Royal Horticultural Society. 10s.

To those who think of rhododendrons and camellias only as expensive luxuries for the few well-kept gardens, this book should do something to bring about a change of attitude. In a lovely old Sussex garden both do, in fact, paint such a picture, but rhododendrons at Colonsay—a windswept island in the North Atlantic—are another matter. But there at Colonsay, Lord and Lady Strathcona have used the little natural shelter and created more to grow a wide range of these fascinatingly varied plants. Just what this entailed is well described.

In this instance, a score of articles and more than thirty well-produced black and white photographs illustrate some aspects of these two families of plants. Camellias are perhaps only for sheltered spots, but their recent increase in popularity is bringing to light many unexpected successes in unlikely gardens. Many rhododendrons, too, prefer some shade in which to develop most successfully, but there are species and varieties for the small garden or for full sun, as well as for the half shade of a thin oak wood, which is probably the ideal situation for most of them.

Any landowner with no lime or chalk in his soil who wishes to plant evergreens which will also give him large colourful flowers for many late winter and early summer months, can look confidently to these two genera as to few others. And especially to help him there is, in this Year Book, some advice on the way to plant an English woodland with rhododendrons, as well as notes on new and established varieties which have recently attracted attention.

F.W.S.

Carnation-Rose Box. (British Standard 2636:1955). British Standards Institution. 2s.

Prepared at the request of the Ministry of Agriculture, and supported by the box manufacturers, this Standard is the first dealing with flower boxes. It should go some way towards overcoming the present difficulties regarding badly fitting lids, unsuitable packing sticks, etc. It provides for a wooden returnable container closely resembling that used at present. Details of internal dimensions, wiring and nailing requirements are givgen in the standard. The method of constructing the container and lid are also explained and illustrated.

Although designed primarily for carrying carnations and roses, the type of box described is also suitable for certain other flowers, such as sweet peas, lilies of the valley and freesias.

It is recognized that large stocks of boxes are held and that no standard can be adopted forthwith. Users will, however, find it to their advantage in the long run to change to standard boxes when making new purchases.

Copies of the Standard may be obtained from the Institution at 2 Park Street, London W.1.

W.H.S.

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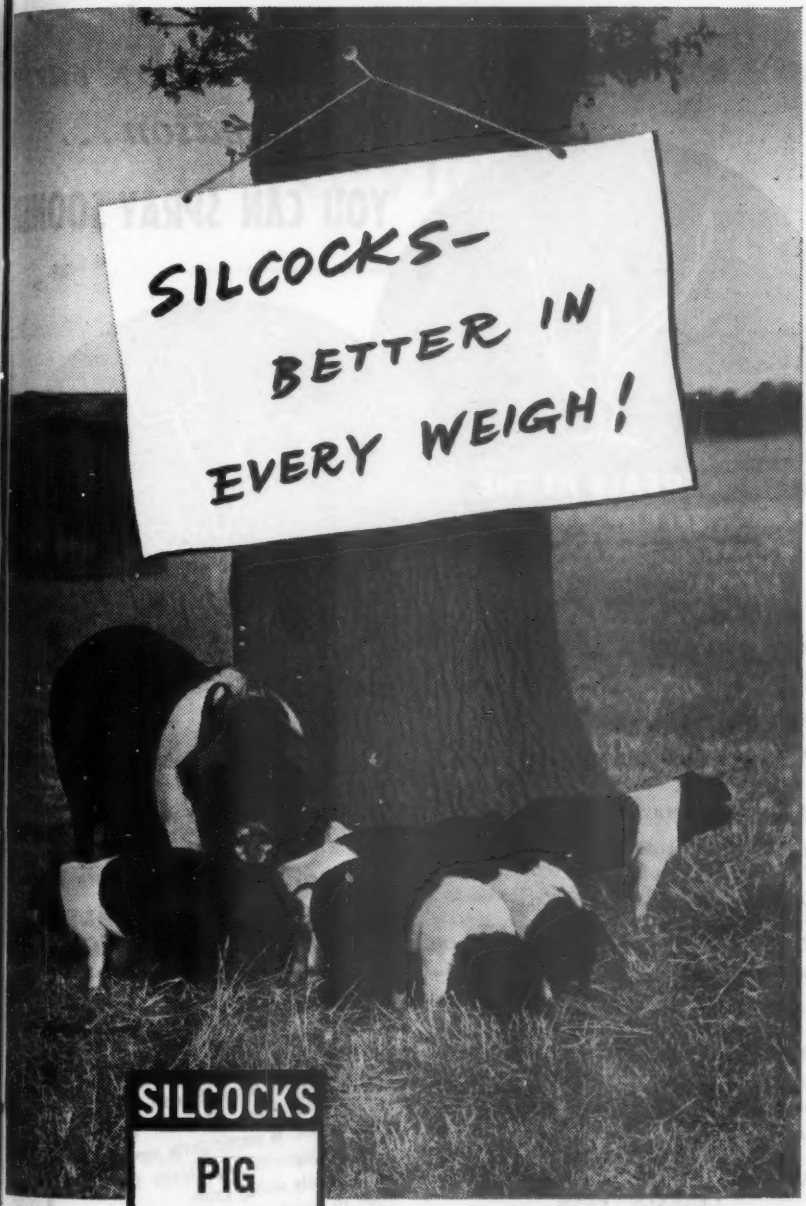
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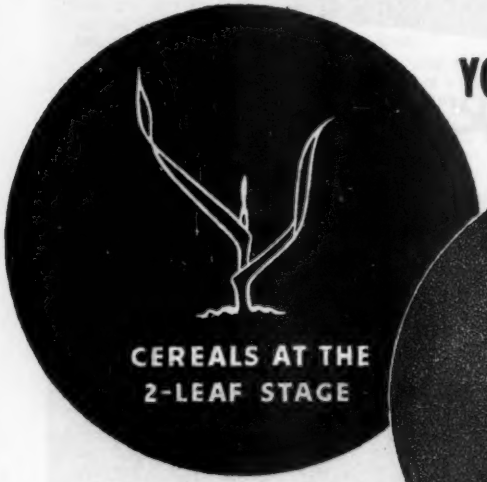

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The Agricultural Review

What the experts discuss in the March issue

For the scores of people who know a lot about any particular subject, there is always one who is the real expert, who knows the latest developments—probably because he is responsible for them—who can speak with authority, because he is the authority. He is the writer for The Agricultural Review on that subject.

In the March issue the range of interest is as wide as ever. For example, *Haymaking with Racks and Tripods*, is investigated by G. Shepperson, Field Investigation Dept., N.I.A.E., who includes some notes on a new tripod haymaking machine.

There's a fascinating story behind the *Discovery of B.H.C., MCPA and 2,4-D;* these achievements by I.C.I. research workers are told by Dr. E. Holmes, Technical Director of Plant Protection Ltd.

Important to poultry keepers is the article by Dr. R. F. Gordon, Director, Poultry Research Station, Houghton Grange, Hunts, on *Incubator Hygiene in the Control of Egg-borne Diseases.*

The present position of *Wheat Bulb Fly* is examined by H. C. Gough, N.A.A.S., and M.D., Austin deals with *the Control Results on Fruit Tree Red Spider in* 1955, when special problems arose.

Other articles are by F. G. Sturrock, Provincial Agric. Economist, School of Agriculture, Cambridge, on *Full Employment in Farming*, and Professor T. Wallace, Long Ashton Research Station, who summarises the *Latest Recommendation on Fruit Manuring*, in which he covers the effects of excess and deficiency of the main plant nutrients and trace elements.

These are only some of the important articles in the March issue. There are also the regular monthly features—book reviews, abstracts from current research papers and a comprehensive economic review prepared by the Economist Intelligence Unit. The March Agricultural Review is now on sale.

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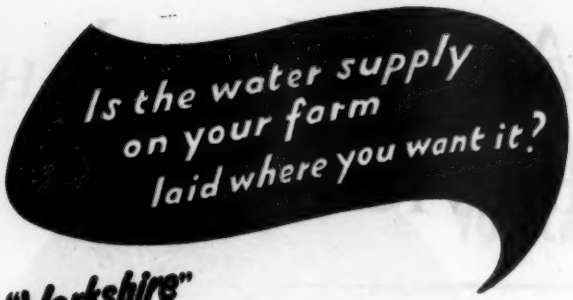

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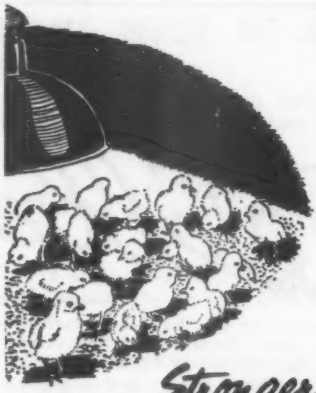

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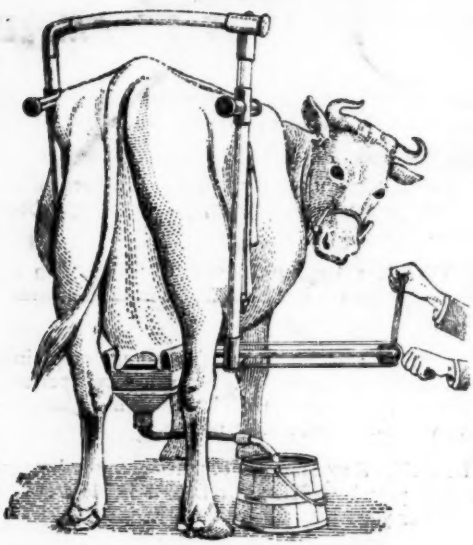

Much to the cow's surprise

As far back as the 1860's, writers were protesting that the poetry of rural life was being destroyed by mechanical appliances. A London magazine lamented: "And now we are called upon to dismiss the ruddy milkmaid: *a machine has been invented for milking cows.*" This particular invention seems to have had no commercial success, but in 1892 the idea was revived in the form shown above. The cows, said a contemporary report, offered no objection—though the one depicted certainly looked mildly astonished. Perhaps it missed that personal touch.

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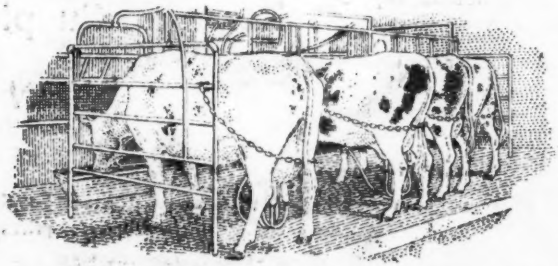

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